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# INTRA-ABDOMINAL PHOTOGRAPHY IN COLOR


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TO include in a hospital chart a photograph in color of an altered structure together with a report on the micropathology of the same tissue will add value to the record. This is particularly true of intra-abdominal disease, in the presence of which the usual methods of physical diagnosis, as palpation and auscultation, are often unsatisfactory and the laboratory tests inconclusive.

The photograph of the liver (Fig. 1, frontispiece) shown in this article was taken by a camera attached to the eyepiece of a peritoneoscope. Biopsy photomicrographs from the same case are reproduced in Figures 2 to 4.

The case history need only be briefly outlined since the intent of this paper is to describe a technique for intra-abdominal photography. The patient is a white male, aged 43 years, with an uncontrolled diabetes mellitus, the fasting blood sugar being 337 milligrams per 100 cubic centimeters. He is one of several cases in a study of liver changes in the diabetic. The peritoneoscopic examination was reported as follows: "The liver is normal in color, the edges are soft, round, and flexible. There is a filigree scarring over the surface of the dome on the right side, which is otherwise quite normal. Three biopsies were taken for hematoxylin and eosin, fat, and glycogen stains." The photograph shows the region of the notch of the liver with portions of the right and left lobes, and the round ligament as it approaches the porta. The tip of each lobe is high-lighted.

Not observed by the examining eye but suggested in the photograph is a greasy appearance of the surface of the liver which may be explained by the increased fat content shown in the biopsy stains. There is an interesting reflection of the round ligament on this surface which appears as an elbow of light extending over the upper portion of the left lobe. There are reasons to hope that the careful, leisurely scrutiny of similar enlarged photographs or their projection on a screen may reveal details of value in diagnosis which are not appreciated during the time of routine peritoneoscopy.

Photographs in other cases have given some additional information. In a case of syphilitic hepatitis with a liver partitioned by broad bands of scar, it was possible in the photograph to discriminate between the lobes involved in the syphilitic process and other lobes which represented only a vigorous regenerative effort. The syphilitic liver tissue was darker in color and covered with a delicate netting of scar; the new liver tissue was light brown in color and smooth, the biopsy showing regenerating liver cells. In cases of cirrhosis the roughened surface of the liver is emphasized by points of light which mark


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each separate nodule. A final evaluation of the merit of intra-abdominal color photography as a contribution to diagnosis cannot be made until more photographs are taken.

In the paragraphs to follow the separate pieces of apparatus are reviewed and the procedures employed in obtaining the illustration are recounted. Mention is made of a few of the obstacles encountered.

*The camera.* Two makes of endoscopic cameras have been manufactured for use with the peritoneoscope: the Güllbring-Jacobaeus endoscopic camera made by the Kifa Instrument Company in Stockholm, Sweden, and more recently an American-made camera of similar design. Pictures from both cameras are sharp in focus and the images are clear. A field-finder incorporated in each camera holds the view except during the moments of exposure when a prism is moved aside and all light strikes the film.

*The camera standard.* Since the exposure time is one-half second it is essential to steady the camera, which must be held in any plane over the operating table. The base of the standard is weighted and to the upright is attached a cantilever arm using a watch-type, flat steel spring to balance the weight of the camera. Near the free end of the arm is a universal joint. From this extends a threaded screw connection to the camera tripod socket.

*The light.* When light is passed through a complex optical system, a percentage* is absorbed by each lens in the series. For this reason the "grain of wheat" lamp on the peritoneoscope is an inadequate source of light for photography in color. In Figure 5,*A* is shown the type of lamp now being used. It is a tubular bulb, one-quarter inch in diameter (T-2) and burns normally at 24 volts and one-half ampere. It is covered with a clear plastic coating to prevent shattering. For our photograph two of these lamps are placed in tandem on a "light-carrier" (Fig. 5). These lamps together may be overvolted to 40 volts and 1.5 amperes. Since this is just below the melting point of the filament, the lamps are burning at their top light efficiency. Their life at this top burning is 10 to 20 seconds. The curved reflector (Fig. 5,*B*) of the light carrier is chrome-plated, highly polished, and increases the light 50 per cent. In this manner the equivalent of the light from an 80 watt lamp may be directed onto a field 2 inches in diameter and at a distance of 1.5 to 2 inches. (To compare the light intensity with that of a lamp commonly used in the home is quite inaccurate, but is an expression that can be understood.)

*The lamp base.* Along the thickened rim of each lamp base (Fig. 5,*C*) are bored five wells 1 millimeter in diameter and 1 millimeter deep (Fig. 5,*D*). Into these a steel pin (Fig. 5,*E*) is placed and used as a key to turn the lamp into its receptacle.

*The power source of the light.* The power source of the light is two 45 volt dry batteries in parallel. This is well under the limit of complete safety which is considered to be 60 volts. The current is regulated by a rheostat and measured by a voltmeter and ammeter.

*The film.* The color film used is the fastest to be obtained; and possesses dramatic color values. The transparency obtained with the endoscopic camera is 4.5 millimeters in diameter, from which high quality wash-off relief prints 3 inches in diameter have been made (Fig. 1). The size of the projected image is adequate for lecture room demonstration.

## TECHNIQUE

The procedures employed in taking the photograph begin with the guiding of the light-carrier and its rod extension (Fig. 5,*F*) along the side of the peritoneoscope trocar, which is already in place. By the use of a hemostat with long narrow pointed blades the opening into the peritoneal cavity is sufficiently enlarged to admit the light-carrier which may be shoehorned between the blades into the pneumoperitoneum space. A single deep silkworm suture is taken between the rod and trocar in order to prevent the escape of air between these instruments. In this way the domed air space overlying the viscera is preserved, the pneumoperitoneum pressure being 12 to 18 millimeters mercury. Proper lighting of the field is checked with the lamps burning at low intensity. When the picture is taken the lamps are overvolted and the camera shutter is opened. The patient is

*The average is about 5% for each glass-air surface.

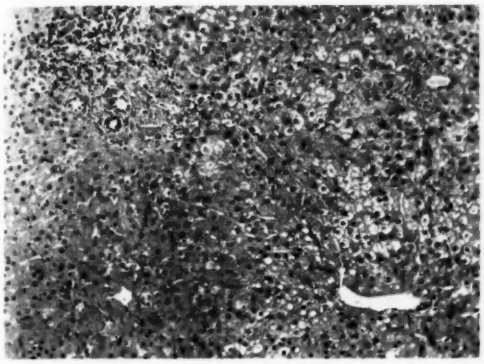

Fig. 2. Biopsy section (hematoxylin and eosin, ×87.5). There is some increase in fibrous tissue about the trinity and round cell infiltration. The liver cells contain a number of small and medium sized vacuoles.

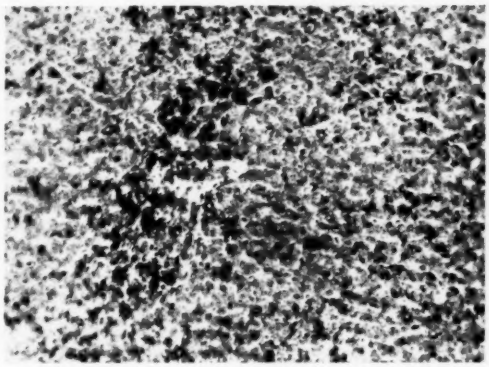

Fig. 3. Biopsy section (Sudan IV, ×87.5). This section shows that the vacuoles take the fat stain.

asked to hold his breath during the time of exposure. The time required for the examination including a diagnostic survey, the biopsies, and photograph need not be more than 30 minutes.

*Obstacles.* Many obstacles not anticipated in planning for the technical procedure of intra-abdominal photography were encountered. A few are of sufficient interest to be described, and of these the need for ever-increasing light intensities presented the chief difficulty. As stated previously, the small lamp supplied with the peritoneoscope was an insufficient source of light, and when overvolted required exposure times of 15 to 30 seconds; with slower films a full minute.

Efforts to obtain very short exposures by the instantaneous flashing of lamps of various types failed to produce more than the faintest outlines on color film. Nor did the flashing of lamps at higher voltages—to more completely consume the lamp filament—impressively increase the light values. It has not yet been possible to make a photoflash lamp using a quarter inch or T-2 type of bulb.

During these experiments with lamps, the glass occasionally would crack and the need for a protective coating became apparent. A clear plastic outer coating was applied and has been satisfactory. Sterilization in the autoclave would cause fogging and peeling of the plastic unless the lamps were placed in a corked test tube from which all moisture had been driven by heating.

Another problem involved the escape of pneumoperitoneum air between the trocar and the rod of the light-carrier. Various trials with rubber dams and sliding corks were unsuccessful. It was learned that a suture taken deep into the subcutaneous fat between the instruments would in most cases hold the pneumoperitoneum.

In the earlier experiments the peritoneoscope was introduced through the cannula of one trocar, and the light through an entirely separate cannula often placed at a point several inches away. Because of this arrangement it was possible to observe with the peritoneoscope the passage of this second trocar through

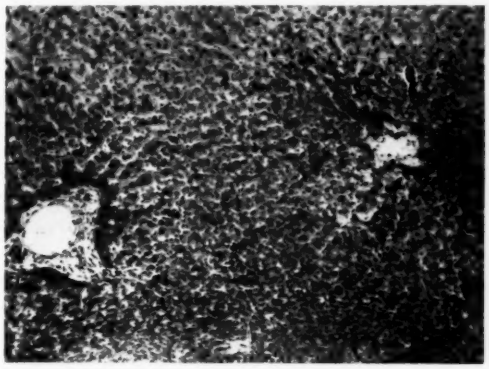

Fig. 4. Biopsy section (glycogen stain, ×87.5). There is an impoverishment in the glycogen content of the liver.

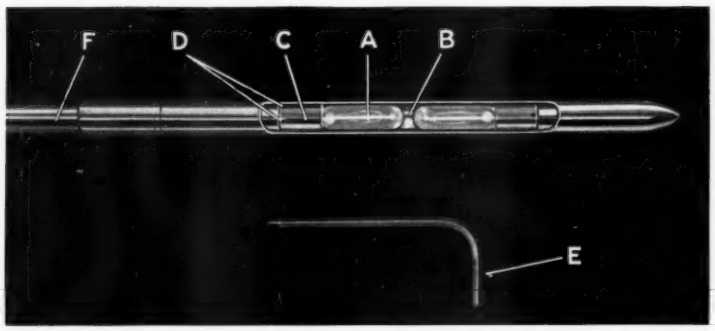


Fig. 5. The "light-carrier." *A*, lamp, (T-2 bulb, G.E.); *B*, reflector; *C*, lamp base; *D*, wells; *E*, key; *F*, rod extension.

the anterior abdominal wall. Sometimes the peritoneum could be seen to tent far into the air space before the point of the instrument would pierce the lining membrane. A curious misadventure occurred in a single instance when a trocar, placed at its usual depth, could not be maneuvered freely in the intra-abdominal space. Observation with the peritoneoscope revealed that it had passed *exactly* between the layers of the falciform ligament without entering the peritoneal cavity. The point of the stylet was impinging on the round ligament.

The presence of motion within the abdomen has presented, fortunately, only a minor difficulty. Since local anesthesia is used the wide excursions of the diaphragm may be halted when the patient holds his breath. Peristaltic activity is gentle and intermittent. Expansile pulsation in the section of the liver being photographed moves along the axis of the object lens of the peritoneoscope and produces little apparent motion. The thrust of the abdominal aorta is transmitted to all structures in the upper abdomen. From pictures taken to date it seems probable that soft livers (hepatitis) will better absorb this motion and give sharper images than hard, fibrous livers (cirrhosis).

A technique which requires the handling of two movable parts within the free pneumoperitoneum space requires an assistant and remains a somewhat difficult procedure. A trocar is now being made with two air locks through which the light-carrier and then the peritoneoscope may be introduced. This trocar will have an outer diameter of 12 to 13 millimeters and is designed to support the lamps in a proper relation to the object lens of the peritoneoscope. The use of a single instrument of this type should greatly simplify intra-abdominal photography.

# COMPRESSION OF THE HEART PRODUCED EXPERIMENTALLY

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IT is my purpose to record observations that I have made in a study of compression of the heart produced experimentally. Most of the observations that I shall record are of a confirmatory nature. Some of the observations are original. The total amount of experimental work that has been done on the subject of compression of the heart is not great. Claude S. Beck (2) in 1929 was the first to produce the condition experimentally. He produced it by the injection of Dakin's solution into the pericardial cavity of dogs. At that time the disease was variously referred to as Pick's disease, adhesive pericarditis, mediastinopericarditis, and constrictive pericarditis. Using this experimental method for the production of the disease, Beck and Griswold (7) in 1930 were able to make observations and studies concerning its physiology and operative treatment. They reported a series of 50 experiments in 11 of which the syndrome of cardiac compression was observed in various stages of development. In some of these animals the condition was completely cured by removal of the pericardial scar. They showed that the heart became smaller as the syndrome developed, and also that the minute volume output of the heart was diminished. They also found congestion in the liver and a fibrinous and fibrous exudate on the surface of the liver. These developments could not be explained on an infectious basis. They also showed that the syndrome could be produced without adhesions. At about this time Churchill (9) did the first successful operation in this country. In 1935 Blalock and Burwell (8) made determinations on the pressure in the thoracic duct. They produced the condition in 2 dogs by the injection of aleuronat into the pericardial cavity. In one of these animals they found that the pressure in the external jugular vein at the end of 3 weeks was 120 millimeters of water, the pressure in the femoral vein was 140 millimeters of water, and the cerebrospinal fluid pressure was 240 millimeters of water. The autopsy examination showed "concretio cordis." The second animal showed signs of illness 17 days after the introduction of aleuronat. The pressure in the external jugular vein was 155 millimeters of water, in the femoral vein 175 millimeters of water, and in the thoracic duct 200 millimeters of water. According to these experiments the pressure in the lymphatic system is increased in this condition.

The most important contribution to this subject was made by Beck when he introduced a new concept to cover this type of disease. His concept was that some diseases of the heart are intrinsic in nature; others are extrinsic. This condition under discussion he claimed was one form of extrinsic disease and he called it compression of the heart. He divided compression into two classes, one acute the other chronic. He introduced a triad of signs for diagnosis. The Beck (3) triad for acute compression was (1) a small quiet heart, (2) a rising venous pressure, and (3) a falling arterial pressure. The Beck triad for chronic compression was (1) a small quiet heart, (2) a high venous pressure in the arm, and (3) ascites and a large liver. Rotation of the heart and angulation of the heart were other forms of extrinsic disease. Adhesions with traction in the long axis of the heart, he showed, were not a form of extrinsic disease. Up to this time writers used the term heart tamponade to designate acute compression. Beck was the first to show that heart tamponade was really compression in the acute form, and he was the first to show its relationship to chronic compression or Pick's disease. It is logical that this terminology should be adopted univer-

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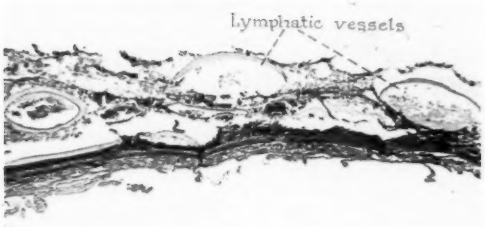


Fig. 1. Photomicrograph of gall bladder showing enlarged lymphatic channels.

sally, and that the terms adhesive and constrictive pericarditis and heart tamponade should not be used.

*Experiments.* For this study I attempted to produce cardiac compression in various ways. The following irritants were used in the pericardial cavity—Dakin's solution, hydrochloric acid in strengths of 1, 5, and 10 per cent solutions, tincture of iodine, collodion, hot, normal sodium chloride solutions, aleuronat, and iodized talc. Rubber bands were placed around the heart and in several experiments the pericardium was reduced in size by plication with silk sutures. The observations carried out in these experiments were as follows: size of the heart by x-ray, venous pressure determinations, electrocardiograms, determination of pressure in the thoracic duct, production of lymph, postmortem studies, results following removal of the compression agent and observations on the coronary arteries.

*Results.* It was difficult to produce chronic compression of the heart because in many experiments death occurred early from acute compression. In other experiments the compression was not sufficient to produce the clinical syndrome and repeated operations were carried out to increase the degree of compression. In all, 146 experiments were done. Twenty-three animals were operated upon twice, 15 were operated upon three times, and 3 were operated upon four times. Acute compression and death occurred in 27 experiments a few hours after operation, and 6 animals were lost within a few days from the operation. This latter group showed signs of both acute and chronic compression. Chronic compression developed in 38 experiments; in 14 it was severe and in 24 not marked.

I found that Dakin's solution was the most efficient method of producing cardiac compression. The initial reaction to the introduction of Dakin's solution into the normal pericardium of dogs consist of tachycardia and hemorrhage. The hemorrhage takes place from the surface of the heart and from the pericardium and is due to the erosive action of the solution. Subsequently the parietal pericardium and epicardium become thickened. Frequently, but not always, the parietal scar becomes adherent to the epicardial scar. Sometimes a layer of fluid is found between heart and parietal scar. The tachycardia can be prevented by the use of procaine applied to the surface of the heart before the Dakin's solution is used (13).

In 16 of the 38 experiments in which clinical evidence of compression developed, I observed the degree of compression to improve after it developed. This improvement was due to absorption of fluid in the pericardial cavity or resolution of thick edematous scar. It is doubtful whether a dense fibrous scar around the heart can stretch or relax sufficiently to reduce the degree of compression after it has once formed. In human patients a dense scar has a tendency to remain stationary or to undergo further contracture with an increase in the compression. If the scar is made up of young connective tissue cells, fibrin, and edema, it is possible for the compression to undergo a reduction in degree with improvement in the clinical condition.

Venous pressures were measured by the direct method from the jugular vein. A right angled glass tube filled with physiological solution of sodium chloride was attached to the vein by means of a needle and the solution was allowed to run into the vein. The height in centimeters was the pressure in the vein. It was my experience that when the venous pressure rose to 8 centimeters within the first 24 hours the dog would die from acute compression. This is not in accord with the experience of Elkin in his patients with stab wounds of the heart. He found pressures of 30 to 40 centimeters of sodium chloride in traumatic cases. Beck (6) placed the fatal level for the acute condition in dogs at 15 to 20 centimeters. I observed in my experiments that the venous

pressure during the next few days either went up or it went down. If the venous pressure showed an early rise and later fell off to nearly normal levels, the animal did not develop ascites. I confirmed Beck's observation that ascites, which occurs only in the chronic condition, appears when the venous pressure rises to about 15 centimeters. It might be stated that it is ascites, and ascites only, that brings the patient with chronic compression to the physician. After the chronic condition becomes established, I obtained venous pressure determinations as high as 30 centimeters of normal sodium chloride solution. In Beck's (5) series of patients the lowest venous pressure was 18 centimeters and the highest was 42 centimeters. It is interesting that the threshold for ascites expressed in terms of venous pressure is the same in the experimental condition as it is in the human patient.

I was interested in making a study of the relationship between ascites and venous pressure. Several experiments were carried out in which warm physiological solution of sodium chloride was injected into the abdominal cavity. I found in these experiments that the pressure in the femoral vein and in the jugular vein became elevated when fluid was introduced into the abdomen. The introduction of 6 liters of fluid into the abdomen elevated femoral vein pressure to 25 centimeters and jugular vein pressure to 10 centimeters. Conversely, in our experiments in which ascites formed as a result of the compression of the heart, it was found that the removal of ascitic fluid produced a fall in the venous pressure. In one experiment removal of 6 liters of ascitic fluid resulted in death of the dog. This is in agreement with Beck's (4) teaching that the high venous pressure is a protection when the heart is compressed and this should be held in mind when the abdomen is tapped. A tight binder should be used after tapping to keep the venous pressure elevated.

An increase in the resistance in the pulmonary vascular bed also increased venous pressure. The injection of one liter of fluid into the pleural cavity increased the jugular vein pressure to 5 centimeters and the injection of 2 liters killed the animal. Increased pressure in the alveolar bed also increased venous pressure. This was demonstrated by introducing air into the trachea by means of an intratracheal catheter. Marked rises in venous pressure were produced by forcible distention of the lungs. It was found that forceful intermittent insufflation raised jugular pressure to 8 centimeters. It was also found that continuous pressure in the pulmonary bed raised jugular pressure to 15 centimeters and a fall in arterial pressure also occurred. These facts have clinical application because if the lungs are forcibly blown up during operation on the heart, the right ventricle can be thrown into failure because of the increased resistance in the pulmonary vascular bed. I understand that this occurred in one of the clinics in this country but no explanation was given for the death. The heart failed when the lungs were forcibly blown up during operation.

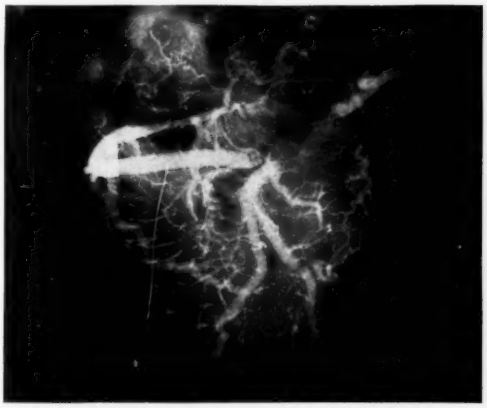

Fig. 2. Heart from dog after production of chronic cardiac compression. The coronary arteries were injected with barium-gelatin mixture and roentgenogram of the specimen was taken. The coronary arteries in this and in other compressed hearts are larger than normal.

*Roentgenographic studies.* The size of the cardiopericardial shadow was increased during the first few days after the injection of Dakin's solution. The increase in size was due to fluid and edema around the heart. The shadow became smaller after the fluid was absorbed. After the cicatrix became organized and underwent contracture, the shadow actually became smaller than it was under normal conditions.

*Lymphatic studies.* These studies were carried out according to the method by Jappelli

used by Lee and Beck (1). A segment of vein is isolated where the thoracic duct joins the venous cistern at the junction of jugular and subclavian channels. A glass tube is introduced into this isolated segment to measure thoracic duct pressures. Lymph flow was determined by direct measurement. In one experiment in which the venous pressure measured 19 centimeters, I found the pressure in the thoracic duct to rise in the manometer to 27 centimeters. In another experiment, the venous pressure was 20 centimeters, and the thoracic duct pressure rose to 26 centimeters in the manometer. Pressure applied to the abdomen forced lymph out of the abdomen and the level rose to 80 centimeters. In 2 other experiments in which chronic compression had developed, the lymph flow was measured. In these experiments I did not find any definite lymphagogue effect.

*Electrocardiographic studies.* Low voltage and slurring were found in the electrocardiograms.

*Autopsy examinations.* The animals with chronic cardiac compression were waterlogged. All veins were distended; many were dilated. The lymphatics in the neck were engorged with lymph. Engorged lymphatic channels were found in the gall bladder (Fig. 1) and in the mesentery of the intestines. The liver was engorged with blood and enlarged. Fibrin was deposited on the capsule of the liver. The interstitial fibrous tissue is increased in the liver. The pericardial scar was variable in thickness and organization. In some cases the scar tissue extended over the venae cavae. The heart showed some degree of atrophy. The presence of adhesions was variable. The coronary arteries were studied after injection with barium. It was my impression that the large coronary arteries were larger than normal. This might be related to increased resistance in the peripheral arterial bed. That the peripheral pressure in the myocardial vascular bed is increased is an assumption. It has not been demonstrated. The observation of large coronary arteries was made in many specimens and is illustrated in Figure 2. It is possible that the atrophy of the musculature makes the arteries relatively large. The brain showed definite signs of edema.

## CONCLUSIONS

Chronic compression of the heart was produced experimentally by the introduction of Dakin's solution into the pericardial cavity, by the introduction of iodized talc into the pericardial cavity, and by placing rubber bands around the heart. The pressure in the lymphatic system is increased when the heart is compressed. The flow of lymph from the thoracic duct was not increased. The electrocardiograms showed low voltage in all leads. The interstitial tissue in the liver is increased. The chronic condition is cured by resection of the compression scar. The coronary arteries appear to be larger than normal in chronic cardiac compression (Fig. 2).

The removal of fluid from the abdomen reduces venous pressure. Forcible distention of the lungs during resection of compression scars increases resistance to the flow of blood through the lungs and elevates venous pressure. Both of these points have clinical application.

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# INFUSIONS OF BLOOD AND OTHER FLUIDS INTO THE GENERAL CIRCULATION VIA THE BONE MARROW

## Technique and Results

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IN 1936, while conducting experiments on transplantation of marrow between animals, it was observed that if two needles were inserted into the marrow cavity of the femur of a rabbit, one at either end of the bone, and 5 cubic centimeters of salt solution injected through the proximal end of the bone, only about 2 cubic centimeters would come up through the distal needle. Repetition of the injection yielded the same results. Examination of the muscle and other tissue adjoining the area of the injection revealed no infiltration with the injected fluid even when the latter was colored. It was evident, therefore, that some of the fluid was being absorbed into the general circulation as fast as it was being injected. Subsequent experiments demonstrated this fact in a more convincing manner (9).

When mercury is injected into the marrow cavity of the sternum (9) or is injected into the tibia and humerus of infants (Fig. 1), the metal may be seen by fluoroscopy to escape rapidly through the emissary veins into the general venous circulation. It has been demonstrated that micro-organisms injected into the bone marrow of guinea pigs may be found in various organs almost immediately after injection (1). These facts indicated the existence of anatomical relationships between the vessels of the bone marrow and the general circulation of a nature heretofore unsuspected. Advantage has been taken of this knowledge to use the marrow cavity as a path for the purpose of the rapid introduction of blood as well as other fluids into the blood stream (10).

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Aided by the Charlotte Cardeza Research Foundation.
Dr. O'Neill, Ross V. Patterson Fellow assigned to the Department of Surgery.

### METHODS

The technique differs slightly depending on the bone that is selected. In the sternum of adults the site of election for the puncture is either the manubrium (Fig. 3), or the body of the sternum midway between the angle of Louis and the xiphoid process. After preliminary injection of the skin, subcutaneous tissue, and underlying periosteum, with procaine, the needle is inserted vertically, with the bevel up and the periosteum is penetrated with a to and fro twisting motion until a good foothold is obtained (Fig. 2, a). Then the needle is tilted until it makes an acute angle of about 30 degrees with the surface of the skin and, with a semicircular to and fro motion, the anterior plate of the sternum is penetrated (Fig. 2, b). A definite sensation of diminution in the resistance of the bone, amounting sometimes to a "trap-door" effect, is felt when the cavity is penetrated. Practice on the cadaver enables one to acquire a clear appreciation of this diminution in resistance.

Once the marrow cavity is penetrated the ball guard is adjusted and the stylet is removed from the inner needle (Fig. 2, c). A syringe containing about 1 cubic centimeter of salt solution is attached to the needle and gentle aspiration is applied. If the needle is properly placed and the marrow is vascular the blood-marrow mixture will, upon aspiration, flow into the syringe with very little effort (Fig. 2, d). The degree of force required to aspirate the marrow gives some indication of its density. Only 0.1 cubic centimeter or less of marrow should be aspirated. The inner needle with the syringe is then removed, flushed through with clear salt solution (Fig. 2, d, inset) and reinserted in the outer needle while alternately aspirating and injecting salt solution through it. The pur-

Fig. 1. Roentgenograph of the body of a newborn infant. Mercury was injected at the upper end of the tibias (arrows) and in the humeri.

pose of this step is to remove air from the lumen of the outer needle. At this point about 1 to 2 cubic centimeters of salt solution is injected into the marrow slowly (Fig. 2, e). Immediately afterward the inner needle is removed (Fig. 2, e, inset) and the adapter from the air-free, salt solution filled rubber tubing and reservoir is attached to the salt solution filled outer needle (Fig. 2, f). Swiftness of manipulation is important to insure against clotting of any marrow in the needle.

Penetration of the bone is accompanied by moderate discomfort. Aspiration of the marrow gives the patient a sensation of drawing which is slightly unpleasant; when the salt solution is being injected there is also slight discomfort. Once these steps have been completed no further discomfort is experienced during the infusion. A few of the children went to sleep while the infusion progressed.

In most instances the flow from the body of the sternum is slow (2 to 4 c.cm. per minute) at first, then within 10 to 15 minutes it is accelerated. If it is necessary to add any material to the burette, it is essential to take the precaution of clamping the tube below the dropper before bringing the burette down. This is to prevent lowering the pressure in the tubing, which would allow the marrow to run up into the needle and plug its lumen. In a child under 3 years of age, the marrow in the sternum is probably not developed to the point that it will allow this site to be used. The sites of choice in babies or young children are the upper portion of the tibia or the lower portion of the femur, at the metaphysis. We have not had enough experience with this method in infants under one month of age to judge of its value in this age group. In a baby, 8 days old, the infusion was abandoned because of a slow rate of flow. But in another, 7 weeks old, 145 cubic centimeters of blood were infused without any difficulty. To avoid the possibility of injuring the epiphyseal cartilage, it is desirable that the needle should be pointed toward the diaphysis of the bone (Fig. 3). The needle should be inserted about 2 to 3 centimeters below the proximal end of the tibia, or in the femur, about the same distance above the external condyle; once the flow has started, the leg should be raised slightly above the level of the body. In children above 3 years of age, and in some adults, it is preferable that the puncture be made in the manubrium of the sternum. The marrow cavity of the manubrium is relatively larger than that of other bones in young children and in most adults the rate of flow is more rapid in the manubrium than in the body of the sternum. Great caution and very little force are necessary in penetrating the anterior plate of the manubrium in children. Needles 1.5 to 2.5 centimeters long only, should be used, to guard against penetration of the posterior plate. The thinness and softness of the bony plates of the sternum in children do not allow as easy a differentiation to be made between the bone and the marrow as in adults. It is only by aspirating with the syringe and obtaining marrow that the operator can be assured that the needle is in the proper loca-

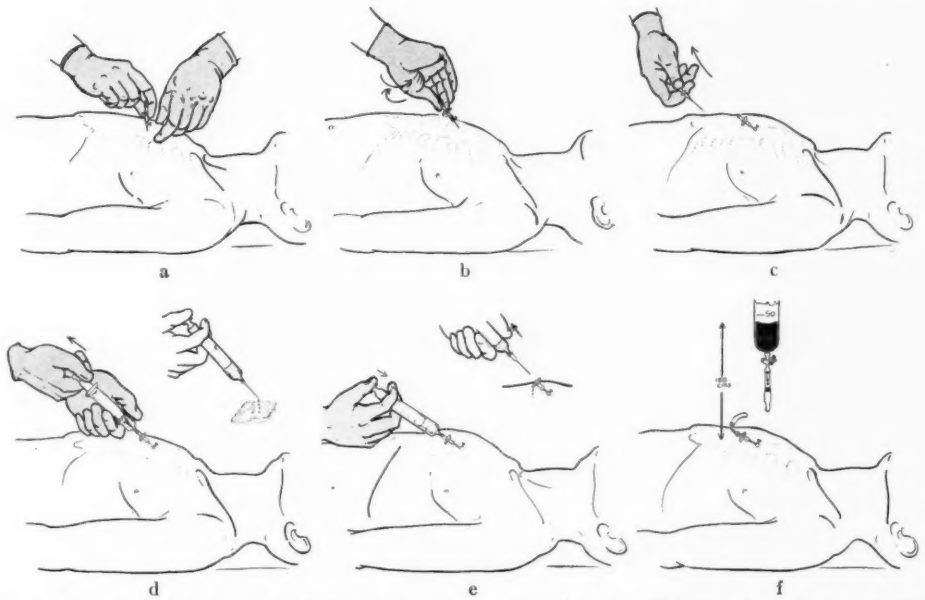


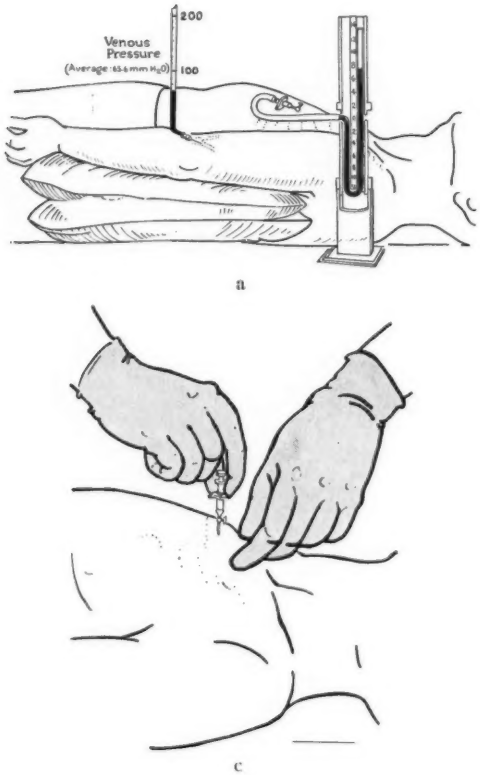

Fig. 2. Steps of the technique for infusing substances into the bone marrow of the human sternum. a, Penetration of skin, subcutaneous tissue, and periosteum; b, entering the bone and marrow, semirotatory motion; c, removal of stylet, adjustment of guard; d, aspiration of marrow, inset, flushing out internal needle; e, reintroduction of needle, injection of saline, e, inset, removal of internal needle; f, connection to gravity infusion apparatus.

tion.[1] In Figure 3 is illustrated the type of a needle used for these infusions. Needles of similar design can be applied to the same end. The purpose of the double needle is to keep from contaminating repeatedly the external needle with pieces of bone marrow when several aspirations had to be tried during the same puncture. Such repeated aspirations increase the likelihood of producing clotting inside the needle with consequent obstruction.

Several precautions should be kept in mind. In general, no material should be injected unless a blood-marrow mixture has been clearly obtained by aspiration. If no blood-marrow mixture is obtained upon aspiration it is because: (a) The needle may not be in the marrow cavity. The point of the needle may be in the substance of the bone or beyond the posterior bony limits of the cavity (posterior plate of the sternum or posterior surface of the tibia or femur) or to one side of the cavity. (b) The marrow is not sufficiently vascular because of replacement by cellular infiltration, fibrous tissue, or bone proliferation. The low incidence of failures in the series now being reported indicates that such changes are not common. (c) The distal opening of the needle may be lying against a spicule of bone. Turning the needle about a semicircle may clear the obstruction.

When the sternum is used care should be taken not to penetrate the posterior plate; if the needle projects far out above the skin it is desirable to equip it with a guard adjustable at any desired level. It is essential that a clear impression of the width of the bone and its approximate center be obtained by grasping the sides of the bone between the thumb and forefinger (Fig. 2, a). The needle is then inserted in the center of an imaginary line between the two fingers, to avoid pointing it away to one side of the marrow cavity. No solution should be injected until the air from the lumen of the needle is removed as previ-

[1]The technical details regarding the application of this method in infants and children will be taken up elsewhere (*J. Am. M. Ass.*, in press). In infants, under 6 months of age, it has been found convenient and even desirable to discard the outer, gauge 15, needle and use the inner, gauge 18, needle and stylet only. In view of the narrowness of the marrow cavity in these subjects, the use of the smaller needle will facilitate penetration of the bone and reduce the amount of trauma.



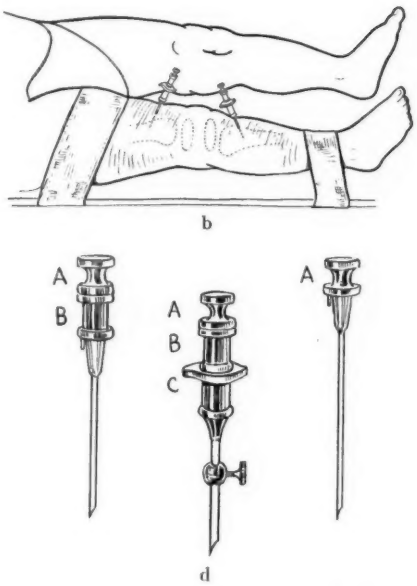




Fig. 3. a, Method of determining intramedullary pressure—average in 13 adults, +78 millimeters water—range, —30 to +200. b, Points of election for puncture in children under 3 years of age. c, The manubrium is the site of election in adults; d, component parts of needle[1]: *A*, Stylet; *AB*, internal needle (gauge 18) with stylet in place; *ABC*, stylet, internal needle and external needle (gauge 15) with guard. Three sizes are desirable: 2, 3.5, and 5 centimeters in length, excluding the hub.

ously mentioned. This precaution is especially important in infants, who, because of their small size, may not tolerate well an injection of even small amounts of air. More than the usual care should be exercised to keep the lumen of the needle clear by not allowing a reversal in the direction of the flow in the needle. A decrease in pressure in the tubing allows the highly coagulable marrow to ascend the lumen of the needle and to clot, thereby obstructing any further flow. If upon entering the cavity no marrow can be removed by gentle aspiration, it is likely that no fluid can be injected. Under these circumstances a search for other bones (e.g. tibia) may yield a favorable site. Sometimes marrow may be obtained easily from the manubrium when an attempt at the body of the sternum has failed.

In Figure 3 is illustrated the method of determining the intramedullary pressure. A tube graduated in millimeters is filled with 3 per cent citrate solution; at first the liquid in the tube drops rapidly until it reaches a height of approximately 100 millimeters from the surface of the chest. When the level of the liquid has remained stationary for at least 3 minutes but may be displaced slightly by the patient taking a deep breath, a reading is made.

## RESULTS

To date 52 trials have been carried out in 40 patients, 17 females, 23 males; 33 of these patients were adults ranging in age from 14 to 80 years. In one patient it was not possible to remove any marrow or inject any salt solution at three levels of the sternum. This patient died after operation about 2 weeks after the attempted infusion; at autopsy it was found that the marrow cavity of the sternum

[1]Needle made by the George Pilling & Son Co., Philadelphia.

was small, dense, and with little marrow in it, the bone itself being unusually hard. In 7 instances the infusions were given to children under 2 years—8 days, 7 weeks, 2½ months, 5 months, 6 months, 10 months, 19 months—the needle being inserted in either the upper portion of the tibia or the lower portion of the femur as illustrated in Figure 3.

The needle has been left in place for periods varying from 7 minutes to 30½ hours. The rate of infusion by gravity is governed to a great extent by the density of the marrow. It has varied between 0.4 of a cubic centimeter to 25 cubic centimeters per minute in the manubrium or the body of the sternum of adults; in the tibia or femur of children the average rate of infusion is between 0.5 and 4.2 cubic centimeters per minute with an average of 1.7 cubic centimeters. By means of a syringe, it has been possible to inject as much as 43 cubic centimeters per minute intrasternally. Such rapid rates of injection are justified only when the patient is in shock. Fluids can then be given rapidly into the sternum with the knowledge that the patient does not feel the added discomfort caused by the temporarily increased pressure in the marrow cavity. The amounts infused by gravity have varied between 50 and 2000 cubic centimeters. The manubrium of the sternum was used 20 times, the body of the same bone 20 times, and the clavicle twice. When the clavicle was used the flow was disappointingly slow. This is probably because this bone is unusually thick and its marrow cavity correspondingly small. Though the clavicle is easily accessible the slow infusion rates render it undesirable as a preferred site. In most instances the flow by gravity in the manubrium was more rapid than in the body. The average rate of flow in the manubrium was 3.4 cubic centimeters per minute (range 0.7 to 25.0); and in the body 3.1 cubic centimeters per minute (range 0.4 to 9.1). The same bone has been used as many as three times within 4 days. In one patient, a woman, the manubrium was used on one day and the body of the sternum, on the following day.

Citrated blood, citrated plasma, 5 per cent glucose solution, and plain physiological salt solution have been infused. In a few instances the infusion was given into the marrow because the usual routes were not available. One of the children (Case 6) was a good example of the type of patient in whom this method would find perhaps its most proper application.

J. H., a boy, aged 6 months, weighed 23 pounds and was edematous and jaundiced on admission to the hospital. His arms and legs were so padded with fat that no veins could be discerned even after long application of a tourniquet. He received three small blood transfusions through the external jugular veins. While the transfusions were being given the boy struggled and the needles came out of the veins. Hematomas and a local cellulitis followed and this made impossible any attempt to re-enter the veins. The red blood cell count at this time was 700,000 per cubic millimeter. The anemia was of the acute hemolytic type (Lederer's). Within a period of 10 days three infusions of citrated blood were given, the first one in the right tibia and the following ones in the right and left femurs, respectively. The red blood cell count rose above 3,000,000 per cubic millimeter and the baby made a slow recovery. A detailed account of this case will be published elsewhere.

Case 24 is another illustration of the use of this method:

E. W., a 25 year old diabetic colored woman[1] developed abdominal pain and rapidly became semistuporous; the blood sugar was 530 milligrams per 100 milliliters of blood and the urine gave a strong reaction for sugar, acetone, and diacetic acid. The patient had had several admissions to the hospital because of coma following alcoholic debauches, gross neglect of her diet, and inadequate insulin therapy at home. In the early morning of the day that we first saw the patient, her coma had deepened, the respirations had become shallow and infrequent, the skin cold, and no pulsations could be felt at the wrist or neck. The resident physician had made several attempts to give insulin and fluids intravenously without success. The veins were collapsed and it was not possible to distend them by the usual means.

On December 30, 1940, at 9:08 a.m., the manubrium of the sternum was punctured; 2 cubic centimeters of a blood-marrow mixture was aspirated. Twenty cubic centimeters of salt solution was injected within 50 seconds. Sugar content of the blood-marrow mixture was: 540 milligrams per 100 milliliters; carbon dioxide combining power was 5 volumes per cent. At 9:10 a.m., 120 units of crystalline zinc insulin was injected into the manubrium. At 9:10½ a.m., 1,000 cubic centimeters of 5 per cent glucose solution was started. The initial rate of

[1]From the Medical Service of Dr. Garfield Duncan, Pennsylvania Hospital.

flow was 11 cubic centimeters per minute, by gravity, from a height of 80 centimeters. At 9:16 a.m., pulse was felt for the first time at the wrist. At 9:21 a.m., pulse was 96 per minute, regular, of fair volume. The patient answered questions. At 9:40 a.m., the pulse was of good volume, the jugular veins distended.

The infusion of 5 per cent glucose was continued at the regulated average rate of flow of 8.1 cubic centimeters per minute until the patient had been given 1,500 cubic centimeters in about 3 hours. Through a misunderstanding, the patient received the next injection of insulin intramuscularly at 11:00 a.m. She died at 12:15 p.m. At autopsy no fluid or blood was found in the thorax. There was a small orifice admitting a small straight pin on the anterior plate of the manubrium. Otherwise both surfaces of the sternum as well as its interior appeared normal. Before the sternal marrow infusions the patient had had several intramuscular and subcutaneous injections of insulin without any appreciable effect on her condition. Stagnation of the circulation was probably responsible for the poor absorption and ineffectiveness of these injections of insulin.

Case 31 furnishes another illustration of the application of the method in an infant.

B. L. (observed by courtesy of Dr. Geist of the Misericordia Hospital[1]) white male, age 7 weeks, had had pyloric obstruction since birth. At the age of 5 weeks a Rammstedt operation was performed, and the usual hypertrophy of the pyloric musculature was found. Following the operation the child continued to vomit and became emaciated—weight approximately 6 pounds. A barium meal revealed almost complete obstruction at the pylorus. It was impossible to detect any veins in any of the extremities suitable for a transfusion. The presence of a gastrointestinal disturbance made it inadvisable to use the intraperitoneal route. The needle was inserted into the lower metaphysis of the left femur and over a 65 minute period, 145 cubic centimeters of blood was infused. The baby was quiet throughout most of the period of the infusion. The following day the plasma proteins were 4.1 grams per 100 milliliter. The baby began to retain all the food and to gain in weight. Seven days following the first transfusion, a second one was given in the right femur. The baby has continued to gain weight and there has been no further vomiting.

There were no immediate or delayed local or constitutional reactions following any of these infusions. For 4 to 5 days following the infusion there was slight tenderness on deep pressure over the site of the puncture. Roentgen ray studies of the bones of the children and of a few of the adults did not disclose any abnormalities aside from the orifices of the punctures immediately following the infusions or 2 to 3 weeks afterward.

In patients who received infusions of blood there were within 24 hours substantial rises in hemoglobin and number of erythrocytes. There were no statistically significant changes in the total and differential leucocyte counts carried out after 4 of the infusions.

The intramedullary pressure was measured in 9 patients either before or after the period of infusion. In no instance was there a significant difference between these readings. Pressures varied between 40 millimeters and 195 millimeters of water. In most instances the intramedullary pressure corresponded very closely to the venous pressure taken at the same time.

### ANALYSIS OF STUDY

Substances have been injected into the marrow cavity with the object of influencing the functional activity of its cells (2, 6). The speed with which such materials enter the circulation must make it unlikely that any effect, beneficial or otherwise, is the result of a local action of the injected substances. Such rapidity of absorption also renders open to question the rationale of the procedure of marrow transplantation as recently advocated and carried out in one patient (8). The transplantation was accomplished by aspirating about 5 cubic centimeters of marrow from a healthy donor and injecting it immediately into the sternum of the receiver. Such blood-marrow emulsions probably do not remain *in situ*, but are scattered through the circulation eventually lodging in the capillaries of the lungs.

This type of infusion should find its greatest use when rapid absorption of unchanged substances is the chief object and the intravenous route is not available. Such may be the case in patients with widespread burns, mutilations, generalized edema, circulatory collapse, and in adults or children who have a poorly developed venous system or who have had their veins rendered useless by repeated punctures or by injections of hypertonic solutions. It may find application under circumstances which do not allow the time necessary

[1]From the services of Drs. Thomas and James A. Kelly.

to find a vein and insert a needle in it, and the accessories required to maintain the needle in the vein. In ambulances (automobile or airplane) and in battle field emergency stations, continuous intravenous therapy is often out of the question. The relative immobility of a needle inserted in a bone might then prove a distinct advantage. When dealing with delirious patients or with children whose soft tissues and constant struggling or stirring render it difficult to keep the needles in the veins the procedure may prove advantageous.

Though blood injected into the peritoneal cavity is said to be rapidly absorbed without much change, it appears that in certain disorders chiefly of the gastrointestinal tract, little or no absorption takes place (7).

The method would seem to be contraindicated in generalized infections accompanied by bacteriemia; the long permanence of the needle in the marrow may encourage the localization of a suppurating process at that point. No hypertonic or other irritating solutions should, of course, be infused through this route because of their possible effect on adjacent marrow and bone.

During any infusion into the bone marrow, some fat is conceivably displaced into the blood stream. There seems to be little ground, however, for fearing any such complication as "fat embolism." Harris, Perrett and MacLachlin calculated the minimum lethal dose of human tibial marrow fat to be 0.9 cubic centimeter per kilogram of body weight when injected intravenously into a rabbit. This would correspond to a single lethal dose of 63 cubic centimeters for a man weighing 70 kilograms. The marrow selected for infusion must be highly vascular, and it is precisely this type of marrow that has the lowest fat content. The bone marrow in children contains relatively little fat (3). Bolle found as little as 2.23 per cent fat in the marrow of a 7 year old child. The average adult human sternum contains 8 grams of marrow, approximately 25 per cent of which (2 gm.) is fat. When fluids are infused into this marrow, they immediately make their way into the blood stream via the veins nearest the point of injection, so that only a small fraction of the fat content of the marrow is disturbed.

## SUMMARY

Fifty-two infusions of various fluids into the bone marrow of 40 patients (33 adults and 7 infants) have been carried out. There were no local, constitutional, immediate, or delayed reactions accompanying or following any of the infusions. From 50 to 2,000 cubic centimeters of fluid have been infused at a rate of flow by gravity varying between 0.4 and 25 cubic centimeters per minute. Either the manubrium or the body of the sternum is the site of election for this procedure. The intramedullary route is indicated whenever a rapid absorption of unchanged substances is desired and the intravenous route is not available.

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# ACUTE APPENDICITIS IN CHILDREN

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IN recent years a number of authors have deplored the increasing mortality in cases of acute appendicitis as observed throughout the country. Old age and extreme youth have been emphasized as periods in which the mortality is particularly high. In view of the advances in medical care and in surgical management, this is the reverse of the expected. The experience of various authors reporting the outcome of appendicitis in children within the past few years is summarized in Table I, showing clearly that with one or two exceptions the average mortality for appendicitis with abscess formation or with complicating peritonitis remains unduly high.

Our purpose in this paper is to present the results obtained in the treatment of acute appendicitis in infants and children at the Babies' Hospital over a period of 5½ years, and to suggest that with co-ordinated medical and surgical care the mortality rate in the younger age groups can be maintained at a comparatively low level. The records of patients admitted between January 1, 1935 and June 30, 1940, with the diagnosis of acute appendicitis, have been reviewed in detail. This series is in direct sequence with the report of Caldwell covering the period 1930–1935 at the same hospital. Data were tabulated on a "check sheet" similar to that employed by Hudson and Chamberlain.

*Classification.* All cases from which the appendix was removed have been studied personally by the authors. Only cases in which the primary disease was in the appendix are included. When either the pathological report or the operative impression was not one of appendicitis, the case was deleted. In order that no fatality might be omitted through clerical error, all hospital deaths for the given period were checked.

The cases were divided into two groups: (1) acute appendicitis without perforation, (2) acute appendicitis with perforation. Group 2 was further subdivided. These subdivisions of "localized," "spreading," "diffuse," and "generalized" peritonitis are admittedly impressions for, as Ladd (15) has said, "No surgeon really knows how diffuse the process is unless he has done a very improper operation." "Generalized peritonitis" was reserved for a relatively small group of patients. Such classification was felt to be justified as they all subsequently developed multiple purulent intra-abdominal collections. Special consideration was given to abscess. Instances in which there were a few cubic centimeters of pus adjacent to a perforation have been grouped as "localized peritonitis." "Abscess" implies a large suppurative pocket. Table II gives a perspective of the entire classification.

*Etiology.* In recent years fecal concretions, exanthemas (6), infestation with oxyuris vermicularis (3), and trauma (14) have been considered as contributing factors to the development of appendicitis. Although fecaliths and obstructing bands were occasionally found, without adequate controls we were unable to relate their presence to the causation of this disease. Pinworms were found in only two instances, although all removed appendices were subjected to histological examination. We agree with Botsford that this infestation is not a significant etiological factor. Three patients gave a history of a recent exanthema. Measles and scarlet fever complicated the postoperative course once each. Recent trauma of significant severity was found in 5 instances. Four of these appendices were found to be perforated. We feel that such an event is of more importance in suggesting an erroneous diagnosis of ruptured viscus than in explaining the etiology.

*Sex and race.* One hundred seventy-seven patients were males and 149 females. This is more in accordance with the ratio of Hudson and Chamberlain than with that of authors who stress a high incidence in the male. There were 298 white patients and 28 negroes in the present series.

From the Babies' Hospital, New York.

TABLE I.—SUMMARY OF RECENT ARTICLES ON ACUTE APPENDICITIS IN CHILDHOOD

| Source | Acute Deaths per cent | | | Abscess Deaths per cent | | | Peritonitis Deaths per cent | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Allen, P. D. 1937 | 314 | 7 | 2.2 | 154 | 4 | 2.59 | 144 | 25 | 17.4 | Immediate operation. Mortality (1–5 yrs.) 15.2%. 95% right rectus incision. 19 of the deaths occurred within 48 hrs. after operation |
| Angel, F. et al. 1937 | 70 | 0 | 0 | | | | 34 | 5 | 14.7 | 99% McBurney incision |
| Jones, R. Jr. Menefee, E. E. 1937 | 67 | 0 | 0 | 31 | 2 | 6.4 | 26 | 7 | 29.0 | All McBurney incisions. Mortality 15 times their adult series |
| Deaver, J. M. Martin, A. 1938 | 146 | 0 | 0 | 14 | 1 | 7.1 | 75 | 9 | 12.0 | Progressively more McBurney incisions. Mortality 1–5 yr. 21.7%. Expectant treatment rarely used |
| Caldwell, E. 1938 | 103 | 1 | 0.97 | 50 | 1 | 2.0 | 67 | 4 | 6.0 | 5 of 6 deaths within 30 hrs. of operation. No expectant treatment. 210 McBurney; 10 right rectus |
| Hudson, H. W. Chamberlain, J. W. 1939 | 466 | 2 | 0.42 | 156 | 3 | 1.9 | 217 | 21 | 9.6 | Appendix removed in 95% of cases. 39 McBurney; 797 right rectus incisions. Mortality under 4 yrs. 12%. Immediate operation |
| Bruce, G. 1939 | 320 | 0 | 0 | 24 | 0 | 0 | 123 | 9 | 7.3 | Expectant treatment in only 3 cases. McBurney and paramedian incisions equally used |
| Edberg, E. 1939 | 65 | 1 | 1.5 | 83 | 4 | 4.7 | 32 | 9 | 28.0 | These cases are age group 0–5 yrs. In 1638 cases 0–15 yrs. there were 38 deaths (2.31%) |
| Gatch, W. D. et al. 1940 | 521 | 0 | 0 | ? | | | 135 | 4 | 2.9 | Loss of protein explains "toxemia" of peritonitis. McBurney incision. 119 immediate operation; 16 expectant treatment |
| Miller, E. M. et al. 1940 | 629 | 0 | 0 | 228 | 7 | 3.1 | 306 | 56 | 18.5 | McBurney incision. "Immediate" operation except in the abscess group |
| Total | 2701 | 11 | 0.41 | 740 | 22 | 2.9 | 1159 | 149 | 12.8 | |

*Age.* The age distribution is shown in Chart 1. This follows the curve of previously reported series. The age incidence of perforation is strikingly shown. Among all the patients with acute appendicitis, 35.4 per cent had perforation. Between the ages of 1 and 5 years, the incidence of perforation was 71.7 per cent.

*Diagnosis.* Perforation of the appendix without doubt increases the possibility of a fatal termination, and establishes the certainty of a prolonged morbidity. Although adequate medical and surgical care can do much to improve the final result, we believe that early diagnosis is the most important single factor in the control of this disease.

TABLE II.—ACUTE APPENDICITIS
Babies' Hospital, New York, 1935–1940 (July)

| | Acute appendicitis without perforation (64.6%) | | | | Acute appendicitis with perforation (35.4%) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Acute | Acute with positive culture | Gangrene | Deaths | Abscess | Local | Spreading peritonitis | General | Deaths | Total Cases | Total Deaths |
| Private | 27 | 1 | 8 | 0 | 0 | 3 | 1 | 0 | 0 | 40 | 0 |
| 1935 | 18 | 4 | 6 | 0 | 5 | 6 | 5 | 0 | 0 | 44 | 0 |
| 1936 | 26 | 1 | 3 | 0 | 5 | 10 | 3 | 1 | 0 | 49 | 0 |
| 1937 | 17 | 0 | 3 | 0 | 9 | 8 | 3 | 3 | 2 | 43 | 2 |
| 1938 | 29 | 6 | 5 | 0 | 4 | 11 | 5 | 2 | 0 | 62 | 0 |
| 1939 | 27 | 4 | 5 | 0 | 3 | 8 | 2 | 4 | 0 | 53 | 0 |
| 1940 (6 months) | 16 | 4 | 0 | 0 | 7 | 4 | 4 | 0 | 0 | 35 | 0 |
| Totals | 160 | 20 | 30 | 0 | 33 | 50 | 23 | 10 | 2 | 326 | 2 |
| Grand totals | | | 210 | 0 (0.0%) | | | | 116 | 2 (1.75%) | 326 | 2 (0.61%) |

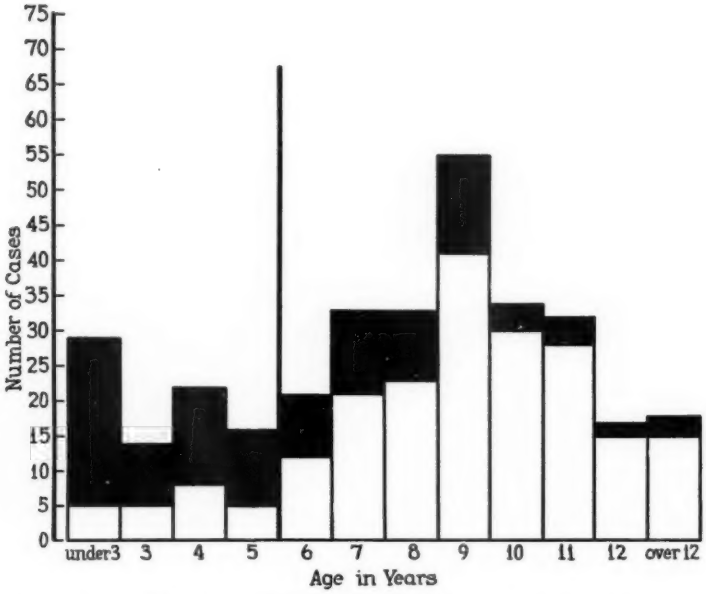


Chart 1. Age distribution. Thirty-five and four tenths per cent, or 116, of all cases were perforated (shaded area). Of the patients of 5 years of age and younger 71.7 per cent had perforations. White areas, acute.

The significance of this is shown in Charts 2 and 3. Only 13 per cent of patients with perforation were seen in the first 24 hours of their disease, whereas nearly 60 per cent of those without perforation were seen during that interval. No patient with appendiceal abscess was hospitalized before the second day of the disease. Some of the factors which may contribute to this delay have been analyzed.

The large proportion of ruptured appendices in patients under the age of 5 years has already been shown in Chart 1. Obviously, difficulties in the accurate communication of symptoms from these patients and the difficulty in evaluating the early physical signs account in part for these high figures. However, we feel that the failure of parents to realize that acute appendicitis may occur in the very young is of greater importance. We cannot emphasize too strongly that episodes which are commonly attributed to "gastro-intestinal upsets" may, in reality, be acute appendicitis. Parental education in this matter has been sadly overlooked.

Catharsis is also related to the all important question of delay in diagnosis. For a number of years it has been stressed that such medication favors the chances of perforation. Bower noted that in patients receiving cathartics 1 in 7 were perforated as opposed to 1 in 80 of the undosed patients. Seventy-three patients in our group received some form of catharsis. Of these 32 were perforated, 41 were not. However, only 1 of the perforated cases was seen in the first 24 hours as against 14 of those with simple acute appendicitis. Of the unperforated cases 6 patients waited 36 hours before coming to the hospital, whereas 15 of the perforated group were first seen after 48 hours of the disease. We do not condone the use of catharsis but would emphasize that the delay associated with the administration of such drugs is of the greater importance.

Despite the policy of this clinic regarding immediate operation, 26 patients with proved acute appendicitis were not operated upon the day of admission. Seventeen of these were in the nonperforated group and fortunately in

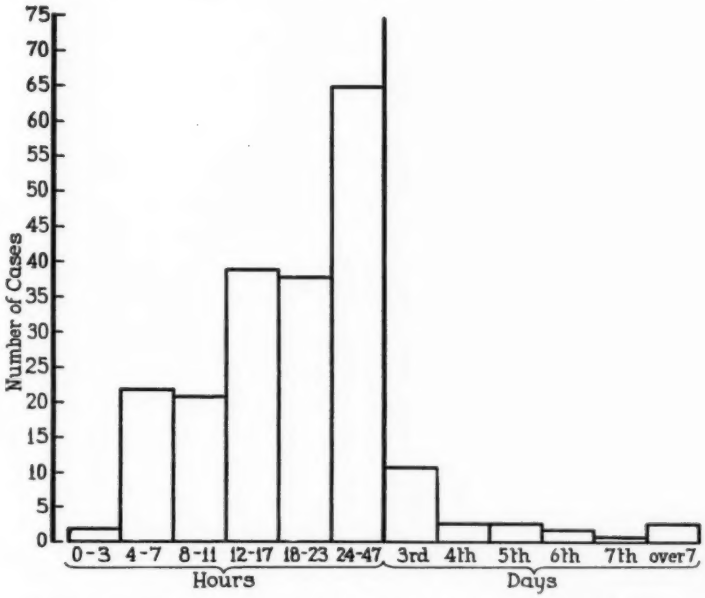


Chart 2. Duration of symptoms, not perforated. Nearly 60 per cent of these 210 cases without perforation were seen within the first 24 hours of the disease. (Compare with Chart 3.)

only 1 case was there an increased morbidity. Of the 9 perforated cases, 4 were purposely delayed and will be discussed further. In 3 others the history of recent abdominal trauma was misleading and they were observed for 24 hours. In the 2 remaining the diagnosis was missed and the delay in operating undoubtedly increased the morbidity in these patients and accounted for their long and complicated postoperative courses.

The history, the temperature, the white blood count, and the physical examination are points which bear on the recognition of the disease and on the estimation of the degree to which the process has progressed.

Most patients had a characteristic history consisting of abdominal pain, fever, and vomiting. In the great majority the pain preceded the vomiting. The duration of the disease is usually brief, since 79 per cent were seen and diagnosed within 48 hours of the onset of symptoms. Most patients had had no previous episodes of similar abdominal pain. Colic-like or cramp-like pain was noted in many instances. In these an inflamed pelvic or midline appendix was frequently found lying among the coils of the ileum. Diarrhea, which often is used as an argument against the presence of acute appendicitis, was encountered in 20 cases.

The preoperative complications were upper respiratory infection, 6 without, 17 with perforation; acute otitis media, 1 without, 1 with perforation; bronchitis, 1 with perforation; bronchiectasis, 1 with perforation; pulmonary tuberculosis, 1 without perforation; genitourinary malformation, 3 without, 2 with perforation; symptoms of infection of genitourinary tract, 4 without, 8 with perforation; vaginitis, 2 without, 1 with perforation; exacerbation of previously drained appendicitis, 3 without, 5 with perforation; abdominal trauma, 1 without, 4 with perforation; recent exanthemas, 2 without, 1 with perforation; rheumatic fever, 1 without perforation; chronic glomerular nephritis, 1 without perforation; tuberculous cervical adenitis, 1 with perforation; fistula-in-ano, 1 without perforation.

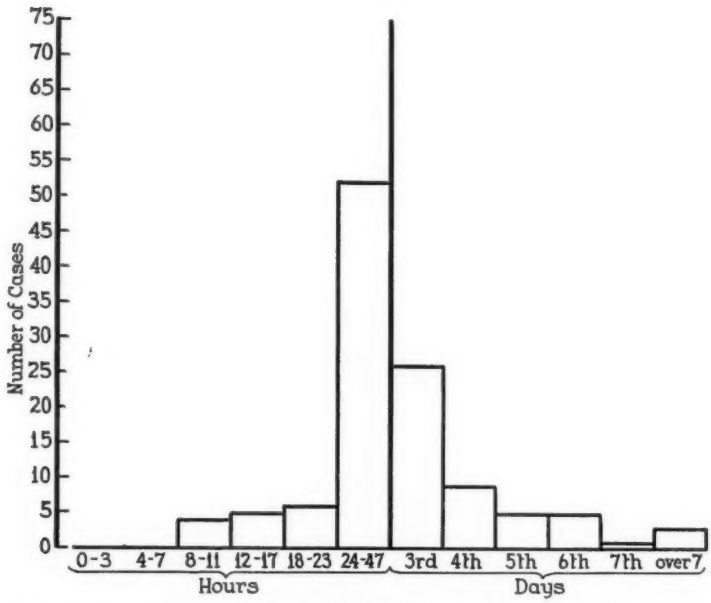


Chart 3. Duration of symptoms, perforated. Only 13 per cent of these 116 perforated cases came to the hospital during their first 24 hours of illness.

From this we conclude that the presence of other known disease, notably upper respiratory infection, should not militate against the diagnosis of acute appendicitis.

Symptoms suggestive of urinary tract disease may be confusing. At least 12 patients complained of frequency or pain on urination. The majority of these were found to have an acutely inflamed appendix lying in proximity to the bladder.

The admission temperatures are analyzed in Charts 4 and 5. Eighty-six per cent of patients with simple acute appendicitis had readings below 102 degrees F. In a suspected case when the temperature is greater than 102 degrees, without other obvious cause, it is likely that simple appendicitis is not present. In no instance was a shaking chill noted. This is despite the fact that many of the children were severely ill and is in contradistinction to the findings in a like group of adult patients.

Charts 6 and 7 demonstrate that little reliance as a differential point can be placed on the leucocyte count alone. The curves for patients with simple acute appendicitis and for those with perforation overlap widely. The frequency curve for suspected cases, in which normal appendices were found, similarly overlaps.

The findings at physical examination varied. However, all patients showed some degree of localized abdominal tenderness. Rectal tenderness or rebound tenderness, increased resistance of the rectus muscles, or a combination of these signs were also usually present. The intensity of these depended greatly on the emotional state of the individual child. All these findings, physical and laboratory, were often extremely unreliable as indices of the true degree of peritoneal involvement. This disparity between preoperative impressions and actual findings at operation is another reason why we never institute expectant treatment on the basis of a preconceived idea of the extent of the pathological process.

*Operation.* It is the policy of this clinic to operate immediately on all patients in whom a diagnosis has been made of acute appendicitis. To this rule there are two possible exceptions. In children who are seriously ill, sufficient

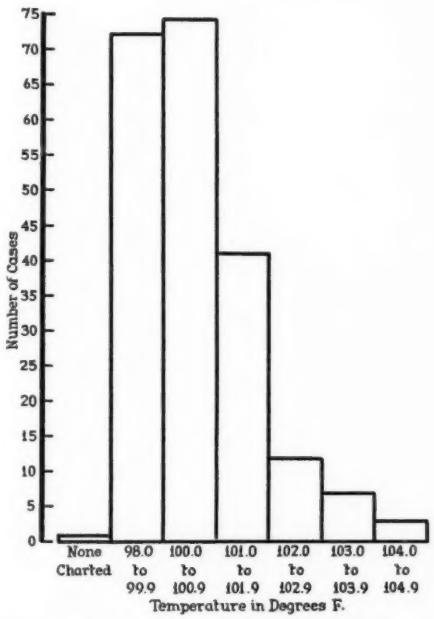


Chart 4. Temperature in nonperforated group. It will be seen that 86 per cent of these patients without perforation had temperature readings below 102 degrees F.

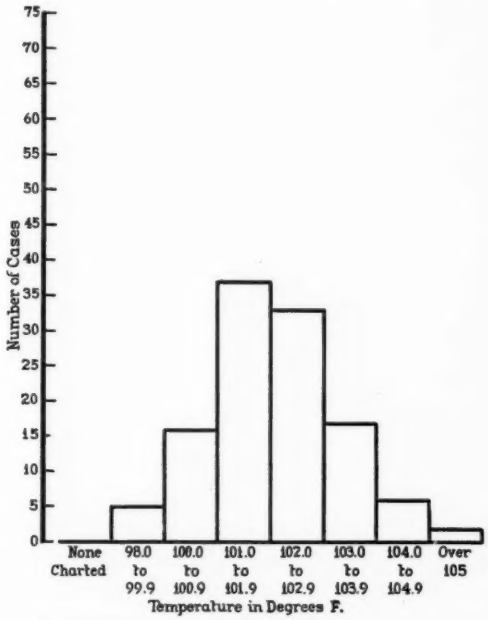


Chart 5. Temperature in perforated group. A trend to a higher temperature range is seen in these perforated cases, but no significant deductions may be drawn.

time is allowed to correct their dehydration, acidosis, and serum protein deficit by appropriate means. The second exception is made, at times, in patients with clear-cut appendiceal abscesses which have probably been present for about 5 days. Such cases will be discussed. This practice of prompt operation is in agreement with the views already expressed—that the mortality and the morbidity are in direct proportion to the time interval allowed to elapse between the onset of symptoms and the operation. We believe that our figures show that there is no advantage in the Ochsner plan of delayed operation even in the advanced cases.

Inhalation anesthesia was used almost exclusively, open ether being given to the great majority. This was felt to be a safe and satisfactory anesthesia to administer in this age group. The postoperative complications of inhalation anesthesia seen in the older age groups were almost never observed in these children. In the last year or two, atropine or scopolamine, with or without nembutal or seconal, have been used with increasing frequency as adjuncts to etherization. It is felt that these drugs promote a smoother course of anesthesia.

Save for a few private patients, the operations were distributed among a group of 10 surgeons.

The McBurney incision was used in all but 11 of the patients. In 6 of these exceptions there was a definite indication, such as a preoperative diagnosis of ruptured viscus or volvulus or a midline mass. We strongly advocate the McBurney approach, since we feel that it has contributed greatly to the low mortality and to a reduced morbidity, especially in the contaminated cases. We agree with Allen's opinion that, in patients with a perforated appendix, better results are obtained if little but the peritoneum is approximated around the drains. This would be a distinctly hazardous procedure in a right rectus incision. In delivering the appendix through a rectus incision, considerably more handling and packing off of the intestine is

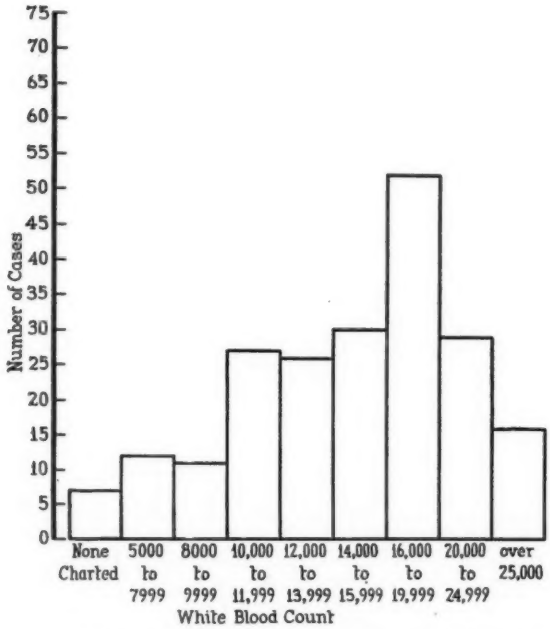


Chart 6. Leucocyte count in nonperforated group. The leucocyte counts in the cases without perforation cover a relatively wide range.

necessary than is required in the intermuscular approach. Furthermore, when drainage is instituted through a right rectus incision, the chance of intestinal obstruction is increased, for a larger surface of ileum tends to be in contact with the drains. In the excellent paper of Hudson and Chamberlain from the Children's Hospital of Boston, a right rectus incision was used in 94 per cent of 839 cases. They have listed intestinal obstruction as a postoperative complication in 20 cases, and 10 of these required a secondary operation. We have encountered moderately severe ileus in 15 patients of our series. Of these, only 3 were considered to be on a mechanical basis and in no instance was a secondary operation for obstruction required. The only instance of wound disruption in our series was in a patient operated upon through a right rectus incision. The majority of authors (Table I) share our advocacy of a McBurney incision. Bruce found little to choose between the two procedures.

The appendix was removed in all the nonperforated cases. In the patients with perforated appendices, the organ was removed save in the instances in which the operator deemed that such a procedure entailed too much manipulation with further peritoneal soiling. There were 13 of these cases. In all of these the appendix was subsequently removed. Five of these were removed during a second acute episode which required immediate operation. This emphasizes the great importance of subsequent appendectomy in those cases in which only drainage is performed at the first operation. Although in 4 of these the delay was the result of lack of parental co-operation, in the fifth the incident occurred within the prescribed "waiting period." We have, therefore, shortened this "waiting period" to 4 or 5 weeks after discharge.

The selection of those patients in which drainage should be employed is often difficult. On one hand there is the group of simple acute

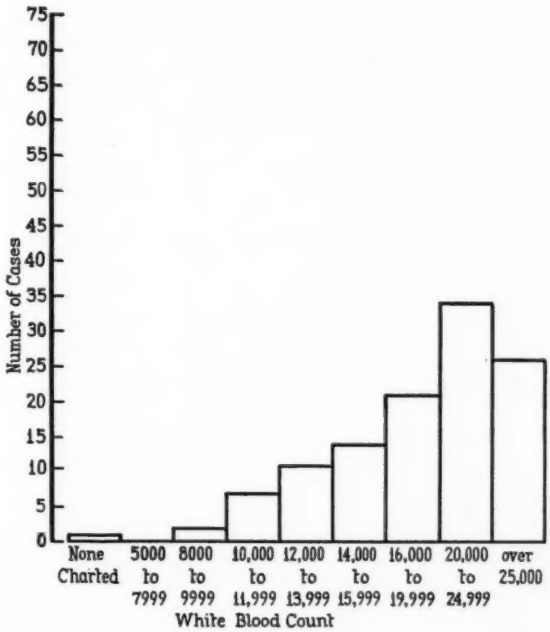


Chart 7. Leucocyte count in perforated group. Although more very high leucocyte counts are noted in the perforated cases, the distribution overlaps those in Chart 6.

appendices in which drainage is not indicated, on the other, the cases with large abscesses which clearly should be drained and between these fall a fairly large number of debatable cases. We have attempted to estimate the advantages of drainage in this middle group, using morbidity as our chief criterion.

Twenty of the nonperforated cases were drained. In 3 of these the appendix was ruptured during removal, in 2 there was a question of perforation. In one instance, considerable induration of the cecum was found in a patient operated upon for an acute flare-up of a recently drained appendiceal abscess. Seven patients had friable retrocecal appendices, requiring dissection during their removal, and were drained. In the 7 remaining, the reason for drainage was not stated. Only 3 of these drained, nonperforated cases were ready for discharge at the expected time, the tenth postoperative day (Chart 8). On the other hand, cultures of the peritoneal cavity, taken at operation, were positive in 25 nonperforated cases. Only 3 of these were drained and there were no complications. Furthermore, 8 of the perforated cases were closed without drainage. Only 1 of these developed a complication, a pelvic abscess which responded to conservative treatment. We feel, therefore, that drainage should be withheld in all nonperforated cases unless there has been unusual tissue damage or gross break in technique. Further a number of cases with early, well localized perforation can be closed primarily without endangering the patient. The judgment of the experienced operator as regards this question of drainage will appreciably and safely decrease the morbidity. Blind adherence to the maxim "when in doubt drain" is to be condemned.

When drainage is indicated, the simplest possible type is used. It is felt that by placing the drains in minimum contact with the bowel and by giving special attention to the pelvis and the lumbar gutter, maximal results can be obtained. In the badly contaminated cases

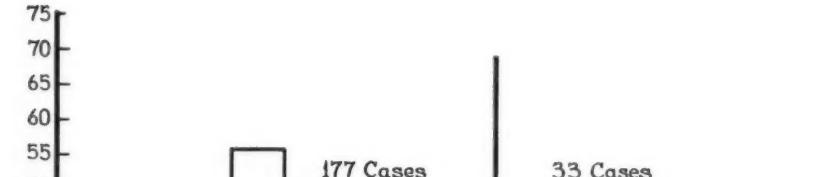


Chart 8. Of the 33 cases that remained in hospital longer than 2 weeks, 9 were drained, 10 had wound complications, 1 developed a pelvic abscess, and in 4 no reason was apparent. The 9 other patients had conditions unrelated to the operation.

loose or no closure of any layer but the peritoneum only was employed. This procedure is known to lessen the extent of wound infection and incidence of postoperative herniation (1).

*Treatment.* In the seriously ill patients, fluid, electrolytes, and blood were given as promptly as possible in order to prepare the patients for early operation. This is an integral part of the policy of "immediate" operation.

The need for postoperative parenteral fluids varied widely. A large group of patients with simple acute appendicitis and early operation were given no parenteral fluids. These patients showed remarkably little reaction to the operative procedure and were able to take adequate fluids by mouth shortly after their return to consciousness. However, many of the children, especially those in the younger age groups, were affected by their disease and by their operation. One indication of the frequency of this metabolic upset was the presence of three or four-plus acetone in the admission urine of 33 per cent (111) of the patients. These were treated after operation with subcutaneous or intravenous fluids in amounts proportional to their body weight. In children with widespread infections and prospects of ileus, infusion by constant intravenous drip regularly was used. The amounts were regulated by the weight of the child, by clinical evidences of dehydration, and by the quantity of fluid obtained by gastric siphonage when that form of therapy was used. Sodium lactate or saline lactate were used in those patients showing clinically or chemically determined evidence of acidosis. Electrolyte solutions were frequently supplemented by plasma (11) when hypoproteinemia was present or expected. This was given through the intravenous drip and was supported by glucose solution when there was prospect of prolonged starvation. Whole blood was administered by separate injection, since the intravenous drips in these children must be run so slowly that clogging, due to sedimentation of the red blood cells, often occurs.

All these therapeutic procedures were prescribed and administered by members of the pediatric interne and resident staffs. These were in constant attendance on the Surgical ward and were thus able to apply their experience in fluid administration in children to these postoperative patients.

In the treatment of postoperative abdominal distention, we have used a Levine tube together with constant siphonage by the method of Wangensteen. This has given satisfactory results. In those patients with extensive peritoneal contamination we have tried to anticipate the expected distention by instituting gastric siphonage immediately after operation. Almost all the patients tolerated this well. By this procedure, we feel that we have frequently avoided the severe distention which would otherwise have occurred on the second or third postoperative day. Attempts to pass a Miller-Abbott tube have so far been almost uniformly unsuccessful in this group of children. We have had no experience with the use of high concentrations of oxygen in the treatment of distention (10).

With the increasing use of chemotherapeutic agents in infections it is natural that they should be applied to peritonitis. In view of their known success in treating infections of the urinary tract by the colon bacillus group of organisms, they have been hopefully applied to peritonitis of appendiceal origin. Favorable experimental and clinical results have been reported. We have employed chemotherapy in 17 unselected cases of peritonitis during the last year and one-half and have found no conclusive evidence of its benefit.

Since the mortality in this series has been almost nil, we have been obliged to resort to other criteria in order to judge the effect of sulfanilamide and its derivatives. One of these is the clinical impression. In the treated group several patients showed a prompt drop in temperature and an early symptomatic improvement. A corresponding number showed no such evidence of benefit. A large proportion of the untreated group showed a similar rapid postoperative improvement. A more accurate criterion was the duration of hospital stay. Six patients with localized peritonitis

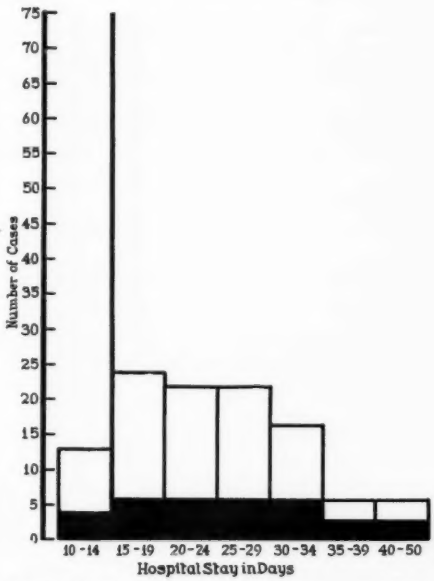


Chart 9. Hospital stay, perforated group. Three patients remained less than 10 days (1 transferred for measles, 1 death, 1 improved; discharged for subsequent operation). Four remained longer than 50 days—(52, 81, 95, 105). White areas, peritonitis cases; black areas, abscess.

received chemotherapy immediately after operation for from 4 to 14 days. None developed major intraperitoneal complications. The duration of their hospital stays were 11, 14, 15, 24, 26, and 32 days. Three patients with diffuse peritonitis received similar treatment. One did well, developed no major complications, and was discharged on the twenty-third day after operation. The 2 others developed pelvic abscesses and remained in the hospital 37 and 43 days, respectively. Two localized abscesses were treated before operation. These patients were not discharged until the 34th and 45th day. Three postoperative abscesses were treated without demonstrable effect. Their respective morbidity was 21, 33, and 39 days

A number of treated patients showed marked irritability or mental confusion which amounted, in several instances, to frank delirium. One child had a severe hemolytic crisis while already in a seriously ill condition.

Comparing the durations of hospital stay of the treated cases noted with the stays of

those who went untreated, no significant difference is found (Chart 9). When the weight of the complications of chemotherapy is added to this, we feel that we have no good evidence of its advantage in appendiceal peritonitis. It is possible that the drugs may have a use as a protective agent in very early rapidly spreading peritonitis.

*Treatment of appendiceal abscesses.* The treatment of appendiceal abscess is a controversial subject (7). It is in this group that delayed operation has been most often recommended. In judging our results we have used duration of hospital stay as the chief criterion, as there has been no mortality under either regimen.

Seven of the 33 patients in this group were treated expectantly. Two had to be operated upon during their hospital stay and had long postoperative courses. In neither could the appendix be removed. Three patients were given chemotherapy and were discharged improved after 9, 25, and 35 days, respectively. On readmission for "interval" appendectomy, they remained 25, 30, and 35 days, and all required drainage. Two patients did well with delayed operation. The average hospital stay of these patients was longer than that of the rest of the group who were operated upon promptly. From a purely statistical point of view in this small series, it would seem that little was to be gained from postponing surgical intervention in appendiceal abscesses. However, we do feel that there are cases with localized signs, mass, and a history of 5 days or more that do better if observed. Such observation should be carried out in the hospital under the close scrutiny of the surgeon in charge. If no improvement is evident within 12 to 24 hours, operation may be performed without any added risk to child. On the other hand at times an unnecessary and possibly damaging operation can be avoided. All these patients should subsequently have interval appendectomies.

*Complications.* Secondary intraperitoneal abscess formation was the most frequent postoperative complication, occurring 29 times. Twenty-two of these had pelvic collections as evidenced by fever, leucocytosis, palpable mass, and a subsequent evacuation of large amounts of pus by bowel or through the operative wound. Five patients formed more than one abscess in the lower abdomen. None of these patients were operated upon for this complication. All recovered. In most it was necessary to resume, during their stage of greatest illness, the supportive measures which have been described under postoperative treatment, paying particular attention to the serum protein. We feel that a conservative attitude toward this type of secondary abscess is of great importance. Although several of these children became very ill, all recovered without undergoing the added danger of operative intervention.

Four patients developed subphrenic or subhepatic collections of pus. None of these responded to conservative treatment, probably because of the more unfavorable anatomic locations of the suppurative process, and all were operated upon, with 1 death. Secondary operations were performed on 5 other patients, once for suture of an eviscerated right rectus incision, once for costal drainage of empyema, and three times for the drainage of wound infections.

*Operations for acute appendicitis, Normal appendices found.* During the same 5½ year period 60 patients in whom the appendices were histologically normal were operated upon as emergencies with the preoperative diagnosis of acute appendicitis. A review of these cases is included in order to give this study a fuller perspective. They may be divided into 4 groups: those in whom no explanation for the symptoms was found (16), those in whom various pathological conditions were found to account for the symptoms (17), those with mesenteric adenitis (24), and those with primary peritonitis (3).

The cases in which no organic lesions were found represent a margin of error in the attempt at early diagnosis and treatment of acute appendicitis. All were in age groups in which the disease is most frequently suspected (all were 6 years of age or more). Although, as we have mentioned, recurrent attacks of abdominal pain were rare in true appendicitis, 11 of these 16 had a history of such attacks. The decision to operate in many of these was influenced by a natural desire to be rid of the

disquieting uncertainty caused by these repeated episodes. Only 3 patients had classical preoperative findings of acute appendicitis.

Acute mesenteric adenitis is frequently indistinguishable before operation from acute appendicitis. Analysis of our 24 cases showed no diagnostic points by which the two diseases could be differentiated. Eleven had pain without vomiting, a relatively infrequent finding in true appendicitis. It often has been expressed that mesenteric adenitis is frequently associated with upper respiratory infection. Only 2 of this group gave a recent history of such a condition.

Primary peritonitis may be extremely difficult to distinguish from peritonitis of appendiceal origin. This is especially true in very young patients. In 3 patients this diagnostic error was made, the organism in all being the pneumococcus. All of these were seen before July, 1937. Since that time we have made increasing use of diagnostic peritoneal puncture. So far this has given conclusive information in all instances in which it has been used, making the diagnosis of appendicitis in three instances. It is conceivable that some cases of very early primary peritonitis will show no organisms in the smears from the paracentesis, under which condition operation may be indicated. This is apparently a safe procedure, for in certain other clinics (16) this diagnosis is regularly confirmed by abdominal incision.

None of these 60 patients showed any untoward effects from the operative procedure.

Approximately, then, for every 6 cases of true appendicitis, one normal appendix has been removed (1 in 10 if the cases of mesenteric adenitis are excluded). Although this figure could doubtless be improved, we regard it as a justifiable margin of error in the effort to diagnose and operate upon this disease at the earliest moment possible. We would prefer to remove several normal appendices if by that means we may prevent a perforation in a patient who is being observed due to diagnostic difficulties. We feel that our mortality figures bear out this view.

*Morbidity and mortality.* The patients with acute appendicitis without perforation are usually discharged sometime during the second hospital week. As can be seen from Chart 8, approximately 50 per cent are sent home on the 10th or 11th postoperative day. Arbitrarily all the patients staying after the 14th day were considered to have an increased morbidity. There were 33, or 15.9 per cent, that stayed into the third week or longer (Chart 8).

No standard could be established for the perforated cases as regards morbidity. The hospital stay of these patients is plotted in Chart 9 for statistical purposes. In all but 6 cases the length of stay was directly dependent upon the number and severity of the peritoneal complications.

The mortality for the entire series is 0.61 per cent, or 2 deaths in 326 patients. This figure must be interpreted in the realization of the fact that the deaths from acute appendicitis without perforation are negligible as evidenced by reports from various clinics. In 2,701 such cases collected in Table I the mortality was 0.04 per cent. In our series there were no deaths in 210 cases without perforation. The mortality problems, therefore, are virtually limited to the perforated cases. There were 116 cases in this group with a mortality of 1.75 per cent. This also should be further broken down, for among the cases with perforation are those with localization or abscess formation, and these have in general been shown to have a mortality of only 0 to 2.5 per cent with thoughtful treatment. There was no mortality in this type of case in the present series. The 2 deaths occurred among the 33 remaining cases, those that had no evidence of localization at operation and were considered to have spread beyond the right lower quadrant. The mortality rate in this subgroup is, thus, 6.06 per cent, a result which shows a marked improvement over the previous 5 year period at this hospital, and which compares favorably with the best reported adult series.

It was particularly gratifying to find that of 81 patients of 5 years or under, 71.7 per cent of whom had perforated appendices, there was but 1 death, 1.22 per cent. This patient was 22 months of age and his case was the only death in 29 children under the age of 3 years.

SUMMARY

We feel that the factors that influence the mortality and morbidity rate in acute appendicitis in children are in order of their importance: (1) duration of symptoms before operation; (2) the type of operative treatment, which includes that given in the immediate preoperative period; (3) the type of postoperative care and treatment, and (4) the age of the patient.

It appears from the data presented that there is nothing inherent in acute appendicitis in children that should necessitate higher mortality and morbidity rates than in adults. Difficulties in obtaining the history or in the interpretation of early physical findings in infants, and anatomical considerations such as the small short omentum and the thinness of the wall of the intestine, will always add to the difficulties of diagnosis and the hazard of the disease in the younger age groups. However, the absence of serious concomitant disease in children, particularly of the chronic type, offsets these considerations. The great recuperative powers and the resiliency of the organically sound child when receiving adequate supportive treatment makes the prognosis better than in the adult with the same extent of disease.

It is believed that the low mortality figures in the series presented are dependent on the combination of several factors employed in the management of these children:

1. Immediate operation, but with the patient fully prepared before operation as far as water, electrolyte, and protein balance are concerned.

2. Routine use of the McBurney incision.

3. Simple incision and drainage if removal of the appendix entails the danger of further spreading the disease process.

4. Parenteral fluids following operation, continuously if necessary, to satisfy the unusual demands.

5. Free use of whole blood and plasma intravenously to combat the protein losses in the presence of extensive peritoneal involvement and secondary abscess formation.

6. Indwelling Levine tube with constant Wangensteen suction not only in the presence of ileus but in anticipation of it.

7. A nonoperative, conservative attitude toward secondary abscesses in the lower abdomen.

Although chemotherapy is of great value in the treatment of complications unrelated to the disease, e.g., pneumonia, we have little evidence of its benefit in peritonitis of appendiceal origin.

In order to give a true perspective to this series, the 60 patients who were operated upon during this same period for presumed acute appendicitis, but were found to have normal appendices, have been reviewed.

We wish to express our sincere appreciation to Dr. Edward J. Donovan on whose teaching and guidance the management of these cases has been based, and to Dr. Rustin McIntosh for his helpful criticism in the preparation of the text; also to the surgical nursing staff of the Babies' Hospital whose thoughtful care has played such an important part in the favorable results in many of these patients.

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# BENEFICIAL ACTION OF OXYGEN THERAPY IN EXPERIMENTAL SHOCK

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A REVIEW of the theoretical basis for the use of oxygen in the treatment of shock was reported in an earlier paper (4). In addition the recent experimental evidence of Wood, Mason, and Blalock showed that following the development of mild experimental shock in dogs, inhalation of a high concentration of oxygen for only 15 minutes had a beneficial action. The average blood pressure was elevated 6 and 7 millimeters of mercury in the dogs in which shock was produced by repeated hemorrhage and by repeated subcutaneous injections of small doses of histamine. No effect was observed upon the blood pressure in their dogs in traumatic shock. In all groups the oxygen therapy caused a decreased pulse, increased respiration, and an increased oxygen content of the arterial and venous blood. Our more extensive studies on traumatic shock showed that oxygen therapy had a definite beneficial action upon the blood pressure and the length of life of the dogs. Of two groups of dogs with an average similar amount of trauma and fluid loss into an injured limb, the group of dogs which was treated with oxygen did not show such a marked fall in blood pressure 4, 6, and 8 hours after injury and lived 70.3 per cent longer than the untreated group. The oxygen content of the arterial and venous blood was also increased by oxygen therapy in our dogs.

This paper reports the results of our studies upon the effects of inhalation of a high oxygen concentration upon peripheral circulatory failure produced by slow intravenous injection of histamine. The report of Wood, Mason, and Blalock contains the results of only 7 experiments in which shock was produced by subcutaneous injections of small doses of histamine. In addition they present only one observation in each case after 15 minutes of oxygen therapy. They stated that their results were less consistent because their method made it difficult to control the degree of shock due to fluctuation of the blood pressure in their dogs. For this reason we have made more extensive studies with a method which makes it possible to reproduce similar depressions of blood pressure with very little fluctuation.

From the Hixon Laboratory of Experimental Medicine and the Department of Surgery, University of Kansas School of Medicine.

## METHODS

Twenty normal dogs in a fasting, basal condition were used in the first part of this study. Only the initial intravenous injection of sodium pentobarbital (25 to 30 mgm. per kilogram of body weight) was necessary to maintain anesthesia throughout the experiment. A kymographic record of the blood pressure was made by a mercury manometer attached to the left carotid artery by a cannula. Respirations were recorded by means of tracings of the chest movements. Hematocrit determinations by the capillary tube method were made every 2 hours upon samples of oxalated blood taken from an exposed right femoral vein. The left femoral vein was cannulated and attached to a Murphy drip. By a constant slow drip administration of histamine acid phosphate in physiological sodium chloride solution (0.5 mgm. per c.cm.), any degree of shock without marked fluctuations in the blood pressure could be maintained over a long period of time and reproduced in all of the dogs. A fatal level of blood pressure of 40 millimeters of mercury was maintained in all of our experiments. The duration of life was noted. Ten of the dogs served as controls and breathed atmospheric air (21 per cent oxygen). Continuous 100 per cent oxygen was administered to the 10 treated dogs by a Heidbrink gas machine attached to a cannula in the trachea.

The effect of different oxygen tensions (10, 15, 20 and 95 per cent) in the inspired air

TABLE I.—LENGTH OF LIFE OF NEMBUTALIZED DOGS IN CONTINUOUS HISTAMINE SHOCK BREATHING ATMOSPHERIC OXYGEN[1]

| Dog | Blood pressure mm. mercury | | Hematocrit | | Length of life Hours |
|---|---|---|---|---|---|
| | Initial | Histamine shock | Initial | Histamine shock | |
| 1 | 130 | 40 | 47 | 65 | 3.6 |
| 2 | 140 | 40 | 41 | 62 | 9.2 |
| 3 | 175 | 40 | 45 | 64 | 3.2 |
| 4 | 140 | 40 | 39 | 48 | 2.0 |
| 5 | 130 | 40 | 52 | 66 | 2.7 |
| 6 | 150 | 40 | 37 | 51 | 9.7 |
| 7 | 130 | 40 | 43 | | 1.5 |
| 8 | 150 | 40 | 55 | 80 | 7.1 |
| 9 | 150 | 40 | 43 | 58 | 11.7 |
| 10 | 160 | 40 | 56 | 61 | 6.0 |
| Average | 145.5 | 40 | 45.8 | 61.5 | 5.67 |

[1]Almost 21 per cent oxygen.

TABLE II.—EFFECT OF 100 PER CENT INHALATIONS UPON THE LENGTH OF LIFE OF NEMBUTALIZED DOGS IN CONTINUOUS HISTAMINE SHOCK

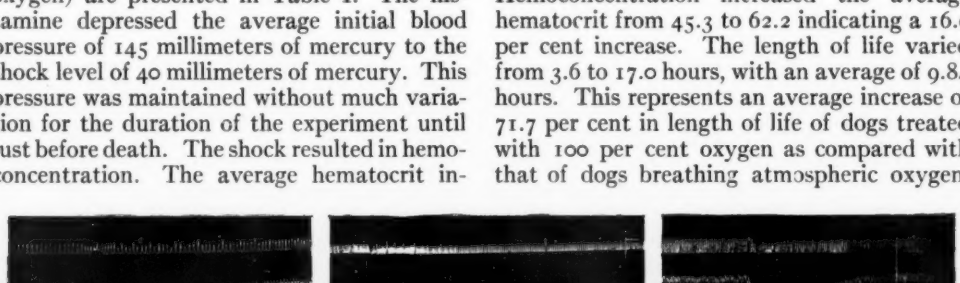
| Dog | Blood pressure mm. mercury | | Hematocrit | | Length of life Hours |
|---|---|---|---|---|---|
| | Initial | Histamine shock | Initial | Histamine shock | |
| 1 | 120 | 40 | 46 | 58 | 15.5 |
| 2 | 90 | 40 | 45 | 62 | 8.0 |
| 3 | 130 | 40 | 41 | 53 | 8.3 |
| 4 | 140 | 40 | 44 | 52 | 11.1 |
| 5 | 115 | 40 | 46 | 65 | 3.6 |
| 6 | 126 | 40 | 51 | 57.7 | 12.1 |
| 7 | 150 | 40 | 51 | 59 | 17.0 |
| 8 | 130 | 40 | 45 | 70 | 3.6 |
| 9 | 150 | 40 | 44 | 83 | 8.7 |
| 10 | 120 | 40 | 40 | 63 | 10.5 |
| Average | 127.7 | 40 | 45.3 | 62.2 | 9.84 |

upon the speed of recovery from histamine shock was studied in 3 dogs. Single intravenous injections of 0.15 and 0.25 milligram of histamine were used to produce the fall in blood pressure.

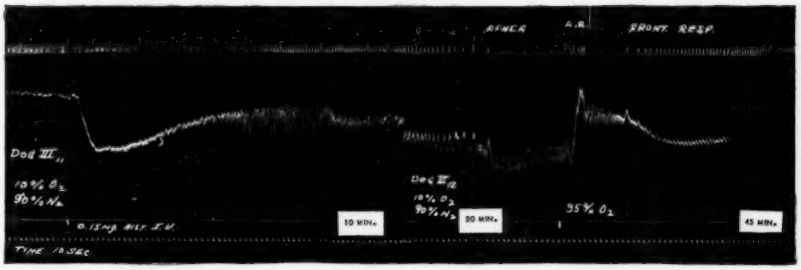
RESULTS

The results upon the control group of 10 dogs breathing atmospheric air (21 per cent oxygen) are presented in Table I. The histamine depressed the average initial blood pressure of 145 millimeters of mercury to the shock level of 40 millimeters of mercury. This pressure was maintained without much variation for the duration of the experiment until just before death. The shock resulted in hemoconcentration. The average hematocrit increased from 45.8 to 61.5 per cent. This is a 15.7 per cent increase. The length of life varied from 1.5 to 11.7 hours, with an average duration of 5.67 hours.

The effects of inhalation of 100 per cent oxygen are presented in Table II. The histamine decreased the average blood pressure from 127.7 to 40 millimeters of mercury. Hemoconcentration increased the average hematocrit from 45.3 to 62.2 indicating a 16.9 per cent increase. The length of life varied from 3.6 to 17.0 hours, with an average of 9.84 hours. This represents an average increase of 71.7 per cent in length of life of dogs treated with 100 per cent oxygen as compared with that of dogs breathing atmospheric oxygen.




Graph 1. Blood pressure response to the intravenous injection of 0.15 milligram of histamine in the nembutalized dog inhaling 20, 15, and 95 per cent oxygen.



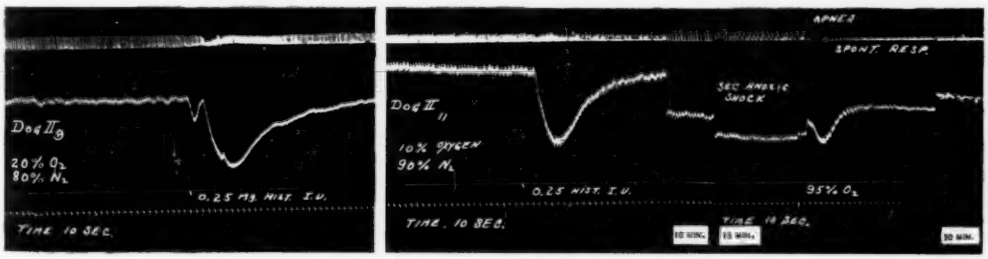

Graph 2. Secondary anoxic shock following the intravenous injection of 0.15 milligrams of histamine in the nembutalized dog breathing 10 per cent oxygen. Recovery after brief artificial respiration and 95 per cent oxygen.

Postmortem examination showed moderate vasodilatation in the intestines. The liver was red and apparently normal in size. This contrasted with the anemic appearance of the intestines and viscera found in dogs dying from traumatic shock.

Repeated intravenous injections of small doses of histamine acid phosphate (0.15 and 0.25 mgm.) produced almost identical depressions in the blood pressure in the same dog. Experiments upon three nembutalized dogs showed that the rate of recovery of the blood pressure after such an injection was decreased if the animal breathed 15 per cent oxygen instead of 21 per cent oxygen. This is shown in Graph 1. When the dogs were given 100 per cent oxygen the rate of recovery of the blood pressure was again normal. When only 10 per cent oxygen was inhaled the initial fall in blood pressure was followed by slow recovery to a level below normal and after 15 to 20 minutes a secondary depression of blood pressure occurred. The initial fall in blood pressure was accompanied by a reflex slowing in the respiration. Slow restoration of the blood pressure from secondary anoxic shock could be produced by the administration of 95 per cent oxygen as shown in Graphs 2 and 3.

## EVALUATION

The slow intravenous drip injection of histamine produced a continuous depression of blood pressure which did not vary much and which was duplicated in a series of dogs. Because of this, it is an excellent method for studying the effect of oxygen therapy upon peripheral circulatory failure. The clinical analogue occurs in anaphylactic shock. Dragstedt and Gebauer-Fueluegg (1) have reported finding histamine, or a histamine-like substance, in the blood and lymph of dogs during anaphylactic shock. The amount was proportional to the severity of the shock. Histamine of similar vasodepressor substances apparently not involved in traumatic shock. Dragstedt and Mead (2) failed to find a vasodepressor "toxin" in the blood and lymph of dogs during experimental traumatic shock. The use of




Graph 3. Secondary anoxic shock following the intravenous injection of 0.25 milligrams of histamine in a nembutalized dog breathing 10 per cent oxygen. Spontaneous recovery following the administration of 95 per cent oxygen.

oxygen therapy in peripheral circulatory failure produced by histamine is logical in view of the depressed oxygen content of the arterial and venous blood of dogs in histamine shock reported by Wood, Mason, and Blalock. Their results show that even 15 minutes of pure oxygen inhalations exert a beneficial action. Our results show that continuous oxygen therapy prolonged the life of the dogs by 71.7 per cent. Our results also confirm their report of hemoconcentration in histamine shock.

The experiments with repeated single intravenous injections of 0.15 and 0.25 milligram of histamine demonstrate the rôle that oxygen plays in the normal reactivity of the vasomotor system and capillary tone in maintaining the blood pressure. Inhalations of 15 per cent oxygen slowed the recovery of the blood pressure. Anoxia produced by 10 per cent oxygen resulted in a complete failure of the vasomotor mechanism and a secondary anoxic fall in blood pressure developed 15 to 20 minutes after incomplete recovery from the first fall. Slow recovery followed the inhalation of 95 per cent oxygen. A depression of the carotid sinus pressor reflex by the anoxemia is undoubtedly involved in these reactions. Gellhorn and Lambert have shown in narcotized dogs that inhalation of 7 and 9 per cent oxygen greatly reduces the pressor reflexes of the carotid sinus. A greater fall in the carotid blood pressure occurred when the position of the dogs who inhaled 7 to 9 per cent oxygen was changed from horizontal to vertical than when they inhaled 20 per cent oxygen. In addition they reported a diminished response of the blood pressure during anoxemia to a given increase of pressure in the carotid sinus.

## CONCLUSIONS

1. A blood pressure of 40 millimeters of mercury was continuously maintained in 20 nembutalized dogs by the slow intravenous drip injection of histamine.

2. A 15.7 and 16.9 per cent hemoconcentration developed during histamine shock in the 2 groups of dogs studied.

3. Oxygen therapy—100 per cent—prolonged the lives of the treated dogs by 71.7 per cent as compared to the dogs breathing atmospheric oxygen—21 per cent.

4. Anoxemia depressed the capillary tone and the pressor reflex activity of the carotid sinus. This was restored by oxygen therapy.

5. Oxygen inhalation is beneficial in peripheral circulatory failure due to histamine.

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# PAPILLARY ADENOCARCINOMA OF THE KIDNEY

## Hypernephroid Tumors

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THE pathogenesis of epithelial tumors arising in the substance of the kidney has been a matter of dispute for a number of years, particularly since Grawitz introduced the idea that they arise from suprarenal rests caught in the kidney during its development. This idea was enthusiastically accepted, so that all tumors were considered to be "hypernephromas." Stoerk soon threw doubt, however, into the authenticity of this pathogenesis by separating those tumors which showed evidence of tubular and/or papillary formation and by advancing the theory that the latter arise from nephrogenic elements.

The modern tendency is to eliminate the suprarenal genesis and consider the tumors as of nephrogenic origin. It is true that the cells in many of the tumors have the clear, vacuolated appearance that we sometimes see in suprarenal epithelium, and there is the intimate relationship between the cell columns and the thin walled blood vessels, as is normally found in suprarenal tissue. These findings, and the absence of lumina and the papillary feature, led Grawitz to state that they were of suprarenal origin, particularly after he had found suprarenal rests in normal kidneys. A thorough study of the individual tumor, however, will usually show wide variation of histological character, and while the clear cell, the absence of lumina, the intimate relationship with blood vessels may prevail, there will be foci where tubules, papillary arrangement, and granular cells are present.

The most important point in the argument against the suprarenal origin is the lack of evidence of hormone (cortin) activity. The term "hypernephroma," however, has become so thoroughly fixed in the nomenclature of tumors of the kidney that it will be very difficult to eradicate. There is no objection to the use of the term "hypernephroma" if the proper connotation be ascribed to it. The modern term, "hypernephroid," is more accurate but rather bulky.

In spite of the authorities cited, we have not reached the point where we can deny the possibility of a true hypernephroma in the kidney, so at present the classification must be on a rather broad morphological basis.

We speak of a tumor as adenoma, papillary adenoma, adenocarcinoma, papillary adenocarcinoma with clear or granular cells. Whether there is any particularly important clinical significance to this elaborate classification is not known. The solution may be found when the large amount of material in the kidney tumor registry of the American Urological Association is analyzed. It must be remembered that this discussion does not include papillary carcinoma of the kidney pelvis, nor various types of Wilms' tumor, nor the adenocarcinoma of renal blastema.

Lucké stated, "There are many reasons why most pathologists today believe that the so called hypernephromas do not develop from misplaced adrenal tissue, but rather from renal epithelium. Among these reasons are: lack of endocrine disturbance and absence of corticin, the fact that adrenal rests in other parts of the body do not give rise to tumors, the glycogen content in the cytoplasm of cells in hypernephromas (lipoid content in adrenal cells), and the difficulty in understanding why the most common tumor of the kidney would arise from something that does not normally belong to the kidney. All of these facts would indicate that these tumors are true adenocarcinomas."

Read by invitation at the group conference on "Malignancies of the Kidney," Clinical Congress of the American College of Surgeons, Chicago, Illinois, October 25, 1940.

Dr. Ash, Lt. Col., M. C., U. S. A., Curator Army Medical Museum.

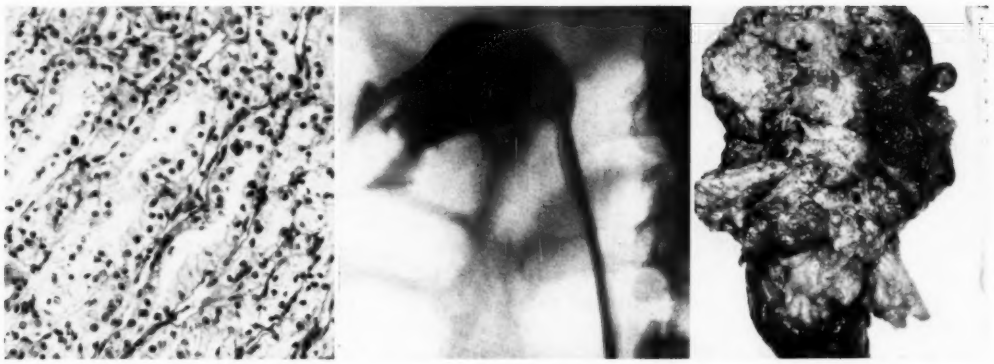

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Fig. 1. Hypernephroid tumor of the kidney in an elderly male. a, High power section showing the tubular formation. b, Retrograde pyelogram with marked downward displacement of the calyces and distortion of the pelvis, producing pyelectasis. c, Large cystic mass involving two-thirds of the kidney.

Papillary adenocarcinoma is the most common tumor of the kidney and occurs chiefly in adults. It is ordinarily located at a pole of the kidney (more often the lower), is a solitary tumor developing to great size, and usually is very vascular. Different portions show great variation in appearance, soft and yellow where the clear cells predominate, dark where there has been hemorrhage, and divided into lobules of varying size by strands of fibrous stroma. There may be cysts or calcification secondary to necrosis of tumor cells. The tumor tends to extend into the pelvis of the kidney and invade the renal vein. It may grow slowly and is often overlooked until evidence of metastasis is found. The lungs and bones are the most common sites of metastasis and as much variation in the histology of the metastatic lesions may occur as in the primary tumor.

Whitmore stated that the most confusing cases were the hypernephroid tumors in which metastases show changes partly hypernephroid and partly sarcomatoid. These findings were explained on the basis of the law of "genetic restriction." As development advanced, a constantly increasing restriction in the differentiation of tissue occurred. The tissue or organ was more rigidly bound to its particular type of differentiation than was the generalized material from which it originally came. In neoplasia, tissues conform to this law, that cells do not necessarily lose their

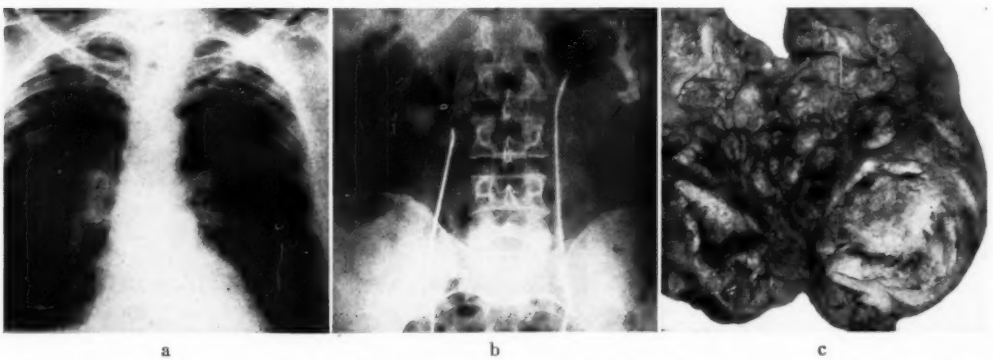

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Fig. 2. Papillary adenocarcinoma of kidney. a, Metastasis to the lung. b, Lateral displacement of the pelvis with marked angulation of the upper portion of the ureter is shown in this roentgenogram. c, This photograph of specimen shows involvement of the entire kidney with an abscess cavity in the tumor.

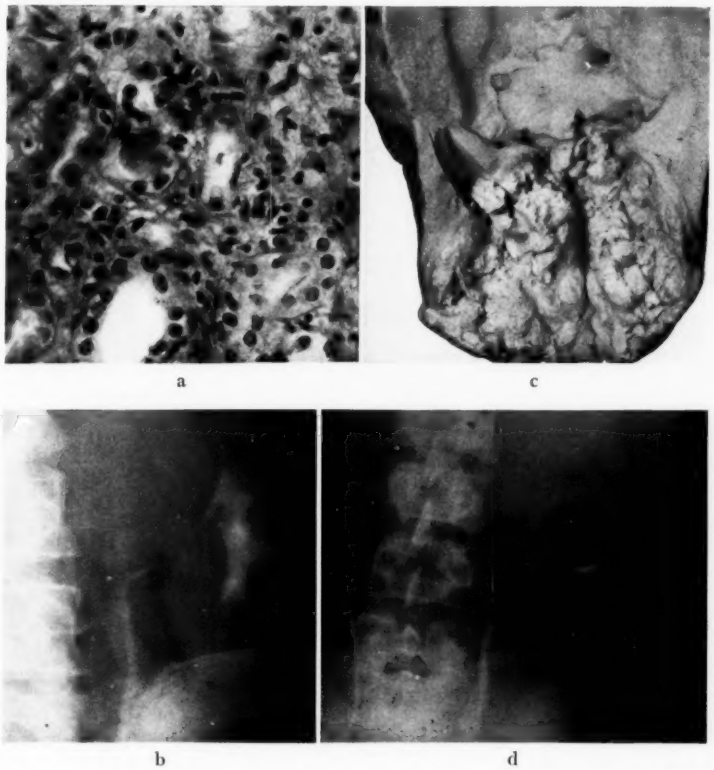

Fig. 3. Papillary adenocarcinoma of lower pole of kidney in an elderly female. a, Shows the presence of kidney tubules with lack of cellular differentiation. b, Retrograde pyelogram showing marked retraction of calyces downward with abnormal insertion of ureter. c, Hypernephroid mass involving the lower third of the kidney. d, Retrograde pyelogram of a gigantic hydronephrosis erroneously diagnosed as a renal tumor and erroneously treated by roentgen-rays. Nephrectomy with recovery.

potentiality to differentiate in more than one direction. One potentiality may become predominant, another recessive.

We will forego further discussion of the pathological varieties of tumor of the kidney and pass on to practical consideration of the diagnosis and treatment.

## DIAGNOSIS

The fact that kidney tumors are difficult to detect early accounts for the high mortality. Recent refinements in urologic diagnosis make it possible to detect the presence of these tumors at an earlier stage and thus reduce the high mortality caused by delay in diagnosing them correctly.

The symptoms of pain, 35 per cent, blood in the urine, 50 per cent, and mass in the flank, 10 per cent, are rarely concomitant, but when present make the diagnosis obvious. We must continue to impress upon the laity the fact that a passage of blood from the urinary tract is evidence of grave import, and that such a sufferer be examined at once. The amount of blood may be slight or profuse and the only finding for a long period of time. Blood clots may block the ureter and cause colic-like pain on the affected side. The fact that bleeding may be painless, intermittent, and of short duration lulls the patient into a false sense of security. An important finding is loss of weight and strength, 15 per cent. The pres-

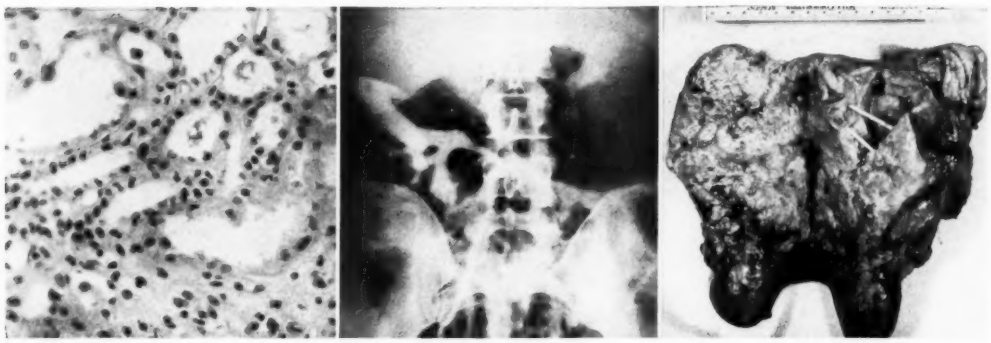

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Fig. 4. Enormous cystic tumor involving the entire kidney. a, Section of tumor showing moderate cellular differentiation with some mitotic figures present. b, Retrograde pyelogram showing marked elongation and retraction with partial amputation of the minor calyces. Downward displacement of the pelvis is also present in this case. c, A large calcified cyst is noted. The mass measured 12 by 24 centimeters.

ence of a large mass in the loin is usually a late manifestation of tumor of the kidney and indicates a poor prognosis.

Metastases (blood borne) may cause gastrointestinal distress, headache, cough, shortness of breath, constipation, and jaundice. Fever, leucocytosis, hypertension, and varicocele on affected side are frequently observed. Renal tumors become very large, tender on pressure, do not move with respiration, and are usually found in patients of from 50 to 70 years of age. Sixty to 70 per cent occur in males, and a majority die within 2 years from cachexia or metastasis.

The study of such a case would include a preliminary intravenous urogram to determine the comparative size, function, and appearance of the calyces and pelvis of the kidney. A cystoscopic examination should then be made, including bilateral retrograde pyelograms and a differential function test. Evidence of retraction, blunting, amputation or absence of a major calyx is the most characteristic pyelographic finding and is present in a majority of cases. The number of calyces involved increases with the size of the tumor, usually but one major calyx being primarily affected. Elongation by extension of the tumor toward the periphery may give the calyx deformity a "spiderleg" appearance.

The absence of deformity of a calyx or of the pelvis may be misleading, as we have seen 2

a b c

Fig. 5. Papillary adenocarcinoma of the left kidney in an elderly male. a, Section of the tumor showing well marked lumen and the typical papillary structure with little cellular differentiation. b, Retrograde pyelogram of the left kidney showing marked elongation of the minor calyces. c, The large mass involving the lower pole of the kidney. Prostatic hyperplasia, producing acute retention, was also present.

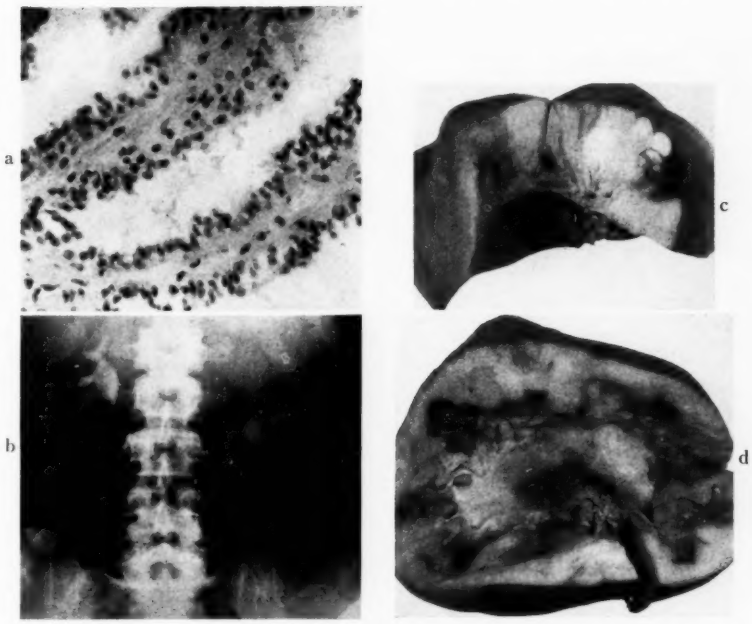



Fig. 6. Malignant papillary cystadenoma of kidney with fungating growth in pelvis. This tumor arose from simple cystadenoma, and represents a subdivision of papillary adenocarcinoma. a, Papillary structure within cystic cavity. b, An intravenous pyelogram. c, Tumor involving the pelvis and cortex seen invading but not extending beyond the renal capsule. d, Fungating growth in pelvis.

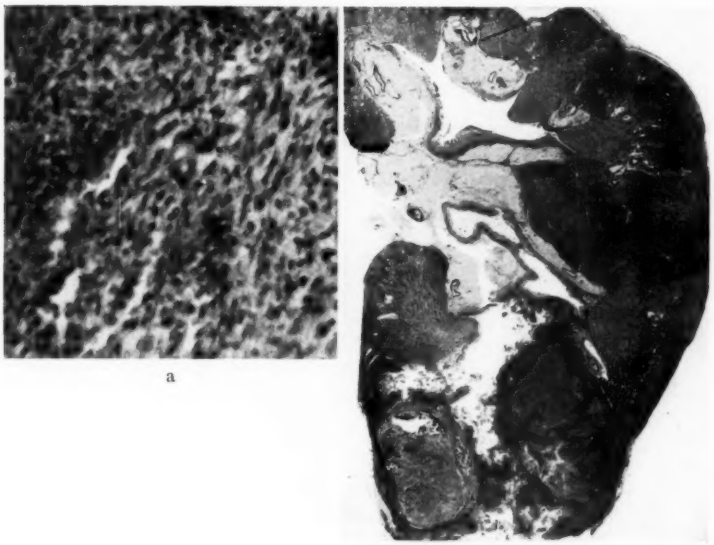
cases in which the calyces and pelvic outline were normal in the retrograde pyelogram, only to find evidence of deformity on intravenous study. Too much reliance, therefore, should not be placed on the findings in a single pyelogram.

Other evidence of deformity includes compression of the pelvis of the kidney, producing flattening, narrowing, or obliteration. Filling defects may be noted, as a result of the presence of blood clots or a tumor. The kidney may be displaced laterally, superiorly, or medially, with abnormal insertion of the ureter. The latter is a very significant finding. Deformity of the ureteropelvic junction or alteration in the silhouette of the kidney is frequently observed.

The differential diagnosis includes pyonephrosis or hydronephrosis, solitary or polycystic kidney and infections producing hematuria and pyelitis cystica or glandularis. Two cases of this type were recently observed. Ptosis, rotation, or the presence of a double kidney may be mistaken for tumor. We have had 5 cases in which prostatic hypertrophy was found in association with tumor of the kidney. Even in a case of prostatism the possibility of a tumor of the kidney should be considered if there is a passage of blood.

On cystoscopic examination, hydronephrosis of the closed type may be difficult to differentiate from tumor, especially when an obstruction is found in the upper ureter. This occurred in 2 of our cases, 1 of which had received roentgen-ray treatments elsewhere for a mass erroneously thought to be a neoplasm. The patient had been assured that this treatment had reduced the size of the mass despite the fact that it contained only urine.

A retroperitoneal tumor (non-renal) may cause marked displacement of the kidney, so the degree of renal mobility should always be determined. There is less retraction of the calyces in polycystic kidney than in



a b

Fig. 7. a, High power section from an adrenal rest tumor, showing sheaths of large polyhedral cells with vesicular nuclei and clear cytoplasm. In many areas the tumor cells are spindle shaped. Other sections show the characteristic papillary adenocarcinoma with well marked lumina. This is an unusual type of tumor (Ewing). b, Whole kidney section with involvement of the lower pole by the tumor described (Whitmore technique).

tumor, and it is usually bilateral. When retraction does occur, however, it is broad, in contrast to the narrow calyces found in neoplasm. The pyelogram in solitary cyst is often unaltered and the urine normal. In one instance, we found the position and axis of the kidney to be considerably altered by the weight of the cyst

An exploratory operation, implying a possible nephrotomy, is never indicated in tumor of the kidney, particularly if the patient has been subjected to preliminary roentgen-ray therapy. Certain of these tumors are so radiosensitive that marked shrinkage will occur following irradiation, thereby distorting the pyelogram and give erroneous conclusions.

Occasionally one sees a case in which evidence of deformity is found on intravenous pyelography, only later to have this proved erroneous by a retrograde pyelogram. This finding has occurred in our experience. In such instances it is important to repeat the retrograde pyelogram at regular intervals until one can rule out the possibility of a tumor. Aspiration biopsy should be practiced in doubtful cases, particularly in suspected cystic disease.

### TREATMENT

The feasibility of operation in kidney tumors should always be carefully weighed. With a history of short duration and the presence of a fixed mass producing toxemia, the advisability of operation is questionable, as the tumor is obviously highly malignant. In such instances, one may proceed with a course of roentgen-ray therapy; and if marked diminution in the size of the tumor occurs, it may be removed 6 weeks later. This delay allows sufficient time for fibrosis of the vessels to take place and also permits the skin to regain some of its vitality.

The question of metastases should always be determined prior to operation, preliminary roentgenograms being made of the lungs, lumbar spine, pelvis, long bones, and skull.

Metastases are more frequent in highly malignant tumors. In some instances, extirpation of the renal tumor and metastatic process has been practiced, the inference being that removal of the renal tumor will slow down the tendency toward further metastasis.

Calcification within the tumor is evidence of necrosis and has little bearing on the degree of malignancy.

The avenue of surgical approach should always be carefully considered in the presence of a large renal mass. The transperitoneal approach offers the best method of obtaining early and adequate exposure of the pedicle and exploration of the renal vein. The mass can then be removed with less trauma, thus obviating the possibility of tumor tissue being squeezed into the renal vein. We remove large tumors by this route and find it very satisfactory. If the tumor is small, involves the pelvis of the kidney, or the diagnosis uncertain, the lumbar route is preferable. Resection of one or more ribs facilitates removal of a large tumor, and should be practiced if the lumbar approach is used.

Roentgen rays may reduce the size of the tumor, and in certain instances it will shrink as much as 40 per cent, thus facilitating removal. This modality does not make an inoperable tumor operable, but in radiosensitive ones it does produce shrinkage. Postoperative radiation in most cases is without value if removal has been clean. Dean stated that recurrence of the tumor cannot be prevented, but that occasionally local recurrences of the tumor in the incision may be inhibited. Nesbit stated that routine preliminary irradiation of a tumor is not practiced in his clinic.

Hand and Broders found definite clinicopathological correlation between the grade of malignancy, operability and expectancy of life after operation.

The fact that one-half of the patients die within 2 years after removal of renal tumors makes the advisability of an operation questionable in patients with large fixed tumors of short duration, in which the general condition of the patient is below par.

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# THE ACUTE GALL BLADDER

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DURING the last 10 years, the debate on conservative versus surgical management of acute cholecystitis has continued with probably more evidence being produced in favor of serious surgical consideration in every case. It has been only within the last 4 years that my personal ideas have come to agree with this latter viewpoint. I can truthfully say that this change has come about through some rather unhappy observations and experiences as well as through a close study of reported series of cases.

This article deals with an analysis and breakdown of 44 cases in which the clinical diagnosis of acute cholecystitis had been made. The cases are divided into two groups. The first group of 22 consecutive cases represents a period in which my policy was not to operate for acute cholecystitis unless certain signs, symptoms, or laboratory findings were reasonably definite, although in several instances the decision to operate was based entirely on that inexact factor of practical medical science called "clinical impression." The second group is comprised of an equal number of cases of acute cholecystitis seen during a later period in which my policy has been to operate more readily unless there is definite early abatement of signs, symptoms, and laboratory findings, with definite improvement in the patient's general appearance and no evidence of that "stationary loginess and apathy" which is often seen in patients with progressive pathological changes of gangrene, abscess, or perforation but whose temperature, pulse, and blood picture approach normal. The lack of parallelism between the pathology and the laboratory-clinical findings is often more astounding in acute cholecystitis than in acute appendicitis, and the clinician's insecurity when attempting to evaluate these patients will be discussed later. It may be said that the first 22 cases were handled under the policy of probable nonoperative treatment with surgery done in only 8 cases, or 36.4 per cent, and the second group under the policy of probable operative treatment, with surgery done in 16, or 72.8 per cent, of the 22 cases. It must also be taken into consideration that this is a breakdown of 44 patients, most of whom had already been hospitalized.

To illustrate further the lack of parallelism between laboratory-clinical findings and the degree of pathological change in cholecystitis, one has only to mention a pathogenesis encountered by every surgeon who performs cholecystectomies, and that is finding an advanced acute gall bladder disease in which the diagnosis of chronic gall bladder disease has been made. Thus, the lack of parallelism can rightfully be emphasized whether we look at the disease from the chronic or the acute phase. Fallis and McClure stated that 10.9 per cent of their 320 cases of acute cholecystitis had been diagnosed as chronic cholecystitis. Wesson and Montgomery reported an incidence of 28.9 per cent in a series of 76 cases of acute cholecystitis. The author's series does not include any cases in which the diagnosis of chronic cholecystitis was made and an acute cholecystitis found at operation, but this is experienced not too infrequently.

Admitting the lack of parallelism, we must then consider the frequency with which the acutely inflamed gall bladder does undergo gangrene, abscess, or perforation with or without analogous variations in temperature, blood, or clinical findings, in order to determine whether these advanced pathological changes occur often enough that we dare not disregard this factor. The majority of authors reporting on this incidence have been forced to place the figure between 10 and 30 per cent. Berk, in an analysis of 8,752 cases reported by many authors, reveals that 1,540, or 17.9 per cent, of these cases progressed to gangrene, abscess, or perforation. Fallis and McClure report that gangrene and perforation occurred

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in 15.9 per cent of their series of 320 cases. Taylor placed the figure at 22.5 per cent of 129 cases and Touroff at 20 per cent of 75 cases. Clute and Lembright reported an incidence of 14 per cent in 29 cases, and Heuer 26 per cent in 153 cases. In considering the mortality for this same group, one finds Fallis and McClure quoting 9.5 per cent, while the mortality for their entire series was about one-half of this figure, or 5.3 per cent. In other words, even though surgery is indicated, and the patients are under the care of surgeons who favor early surgery in acute cholecystitis, there is a high mortality in this group. It would be interesting to know just how high the mortality for the 320 cases would have been if they had been controlled by one favoring conservative treatment rather than operative intervention. No doubt a considerable number were prevented from progressing to gangrene, abscess, or perforation by early operation.

The element of time between onset of illness and time of operation is an important factor to be considered. Taylor reported a mortality of 16.3 per cent for his 129 cases of acute cholecystitis, but analysis shows that for those patients operated upon before the fifth day, the mortality was only 5 per cent, while for those operated upon after the fifth day it was 23.8 per cent. Further analysis shows that the greater percentage of the purulent and gangrenous cases were among those patients operated upon after the fifth day. Clute and Lembright had only 1 death in 29 patients, a mortality of 3.4 per cent, and this was a late case of perforation. Heuer reported a mortality of 3.2 per cent for his 153 cases, but for the 16 patients with perforation the mortality was 12.6 per cent.

It is a rare occasion, however, when immediate or emergency operation is indicated. In most cases, some hours to several days should be given to observation and adequate preparation of the patient for operation, depending somewhat on the assumed pathological picture, or a higher mortality rate will be the inevitable result.

Cave, in discussing the surgical treatment of acute cholecystitis, used the term "immediate" for the first 24 hours, "early" for 48 hours to 7 days, and "delayed" for those cases in which operation was postponed until complete remission had taken place. This seems to be an excellent and practical classification. Fallis and McClure, in their analysis of 320 cases, made the following division: immediate operation—first 24 hours—with a mortality of 8.4 per cent; early operation—24 to 72 hours—with a mortality of 7.3 per cent; and delayed operation—after 72 hours—with a mortality of 3.4 per cent. However, they always followed the practice of operation for acute cholecystitis. Taylor arrives at his mortality figures by grouping his 102 patients into those operated upon within 48 hours of acute onset, those between 2 and 5 days, and those after 5 days, the mortality for the first group being 5.2 per cent, for the second 5 per cent, and for the third 23.8 per cent. This latter high figure dramatically reveals the danger of delaying operation too long. Zinninger, with a similar classification for time of operation, shows an increase in the mortality rate from 6.6 per cent for those in the 2 to 5 day period, to 25 per cent for those after the 5 day period. Carter, Greene, and Twiss, in an analysis of 514 cases of acute cholecystitis, also emphasize the "time element after onset." For 81 patients operated upon within 24 hours of onset, they had a mortality rate of 15.1 per cent; for 137 patients operated upon between 2 and 4 days after onset, 5.9 per cent; for 104 patients, between 4 and 7 days, 7.7 per cent; and for 192 patients, between 7 and 50 days a mortality of 16.7 per cent. Considering the entire group, the optimum time for operation seems to be somewhere between 2 and 7 days, and in view of individual patient variations, this figure of 2 to 7 days is not too wide. My own analysis of some of the cases reported in the literature

TABLE I.—ANALYSIS OF 44 CASES OF ACUTE CHOLECYSTITIS

| | Nonoperative policy | | Operative policy | |
|---|---|---|---|---|
| | No. | Per cent | No. | Per cent |
| Patients not operated upon | 14 | 63.6 | 6 | 27.2 |
| Patients operated upon | 8 | 36.4 | 16 | 72.8 |
| Patients treated | 22 | | 22 | |
| Mortality | | | | |
| Group | 3 | 13.6 | 1 | 4.5 |
| Operative | 3 | 37.5 | 1 | 6.2 |

TABLE II.—AGE INCIDENCE AND OPERATIVE MORTALITY IN ACUTE CHOLECYSTITIS

| Author | Yrs. of age | No. patients | No. deaths | Per cent mortality |
|---|---|---|---|---|
| Fallis and McClure | 30 to 40 | 108 | 1 | .09 |
| | 40 to 60 | 164 | 11 | 6.7 |
| | 60 plus | 48 | 5 | 10.5 |
| Best | 46 to 50 | 2 | 0 | 0 |
| | 50 to 60 | 24 | 1 | 4.1 |
| | 60 plus | 18 | 3 | 16.6 |

and of my personal experiences would seem to favor the "early operation" classification, placing the optimum time to operate somewhere between the second and seventh day, depending upon the individual case. This allows time to build up local and general resistance and immunity, most cases will not have progressed into the most dangerous stage, the patient will not have used up his reserve, and liver damage will not be too great. Cave believes that postoperative deaths are more often the result of liver damage than anything else. From the figures given, it can be interpreted that, if subsidence does not begin promptly and uninterruptedly, there is great danger of gangrene, abscess, and perforation taking place, and the mortality rate will be higher with or without operation as the patient goes by the 7 day period.

In my own series, among the first group of 22 patients in which the general policy was to avoid operation except as untowardly indicated, 8, or 36.4 per cent, proved at operation to have gangrene, abscess, or perforation. These were all individuals over 48 years of age, 6 of them being between 55 and 76 years of age, with an average age of 62 years. Three deaths occurred resulting in an operative mortality of 37.5 per cent, and a mortality for the entire group of 13.6 per cent. Two of the patients who died were 64 and 72 years of age, respectively. Cholecystostomy was performed 3 times with 2 deaths and cholecystectomy 5 times with 1 death. All of these patients were operated upon 5 days or more after the acute onset, and some as late as the twentieth day. It has been said that pathologists see very few cases of perforation at the autopsy table. The answer to that is that hospitals with pathologists usually have capable surgeons who operate when certain signs or symptoms appear or when there is too much uncertainty, and if death ensues the case goes to the postmortem room as an operative death for acute cholecystitis, while in the institutions that do not employ pathologists, autopsies are the exception and no records are available as to what occurs in the particular acute abdomen. Personally, I have seen 2 unoperated, ruptured gall bladders at the autopsy table, one in a patient of my own who refused operation. In the 8 operative cases of this group, the parallelism between the clinical picture and pathological findings was definitely lacking in 4 patients, 2 of whom died.

In the second group of 22 patients, seen during a period when I favored probable operative treatment as heretofore discussed, 16, or 72.8 per cent, were operated upon within 7 days and 6, or 27.2 per cent, fully recovered from the attack of clinical acute cholecystitis without operation. Three, or 13.6 per cent, of those operated upon had marked pathological changes in the gall bladder but no generalized peritonitis because of the protective matting of the greater omentum. This is a marked improvement over the percentage in the first group. Three of the remaining patients had areas suggesting early gangrene, and 2 had acutely inflamed gall bladders with pus in the common duct. In the 16 patients operated upon, the common duct was opened 4 times—25 per cent—stones being found in 3 of these, or 18.7 per cent. Cholecystostomy was done 5 times and cholecystectomy 11 times. All 3 patients with gangrene, abscess, and perforation were over 50 years of age, 2 of them past 60, the average age being 63 years. One death occurred in this group, which gives a mortality of 4.5 per cent for the entire group as compared with 13.6 per cent in the first group, and an operative mortality of 6.2 per cent as compared with 37.5 per cent in the first group. The patient who died after cholecystectomy was 68 years of age, and was not operated upon until the seventh day, at which time a gangrenous gall bladder was found. She was a rather obese woman, with a thick abdominal wall. Her temperature did not rise above 101 degrees, her pulse was 76 to 86, the highest white cell count was 11,000 and this came down to 6,000 on the fourth day. The staff

count varied between 10 and 15 per cent. After the third day, the patient had very little tenderness but she did have a "stationary loginess and apathy" and possibly operation on the fourth or fifth day would have prevented this exodus. Of the 6 not operated upon, 2 have since received surgical treatment, one for recurrence of acute cholecystitis and stones in the common duct, the other because of recurrent acute cholecystitis associated with jaundice and pancreatitis. Both have recovered from their operations.

Since an analysis of all available data reveals that operation for acute disease of the gall bladder after the first or second day does not initiate greater spread of infection or harm to the patient than does operation for ordinary acute appendicitis, and that in both instances mortality occurs in that group which progresses into gangrene, abscess, or perforation, there is considerable evidence and argument that clinicians should not permit cholecystitis to reach such an advanced stage. However, one cannot compare the pathological process of the gall bladder with that of the appendix, in all respects, for cholecystitis usually is caused by a vascular disturbance and most appendices have an inciting infective factor. Studies on the relationship of bacteria to acute cholecystitis by Denton, Wilkie, Branch, and Andrews, as well as some others, have produced rather convincing evidence that infection is not the primary etiological factor. In 1933, Andrews reported from quantitative bacteria studies that no more bacteria were found in acute gall bladders than in quiescent ones. This was true of his studies on empyema and gangrene of the gall bladder also. The authors mentioned as well as others conclude that mechanical and circulatory factors account for the majority of gall-bladder lesions. One should also include the hepatometabolic disturbance resulting in crystallization of cholesterol or the precipitation phenomena which in turn causes trauma of the cystic duct with secondary edema, inflammatory reaction, and subsequent interference with the blood supply. Clute ably compares the early acute gall bladder to an ovarian cyst with a twisted pedicle from the angle of signs, symptoms, laboratory findings, and the postoperative course. Of course, in the later stages the chemical disturbance associated with bile and its closer connection with the lumen of the gastrointestinal tract would tend to make an acute gall bladder a more critical problem, even though the undiagnosed and unoperated upon ovarian cyst with a twisted pedicle is a serious event.

After recognizing the danger accompanying gangrene, abscess, and perforation and admitting the lack of parallelism previously mentioned, we must search for any minor details which may help in earlier recognition of the need for surgery. From my own experience, no symptom, sign, or laboratory finding is infallible, and of late it has been my practice to advise surgery if any one of these is the least suggestive that all is not well. It is hardly necessary to mention here that a septic course revealed by signs, symptoms, or laboratory findings indicates surgery. It must be emphasized, however, that a temperature which does not subside even though pulse, white cell count, and physical findings are normal must be viewed with great alarm, as should an increased pulse rate with normal temperature, white count, and physical findings, or continued pain, tenderness, or rigidity with normal temperature, pulse, and white count. Surgery is probably indicated in all such cases. If the white count remains high, it certainly indicates that complete and safe subsidence has not occurred. In my own experience, too frequently the white cell count has dropped to normal or even subnormal, and later operation has revealed gangrene, abscess, or perforation. However, in most cases in which the white cell count has been misleading as well as the other laboratory-clinical findings, I have found that a careful analysis of the differential white count (Schilling) reveals either a definite swing to the left with increase of the younger forms of white cells or an increase in the staff forms to over 10 per cent. I do not believe that too much emphasis can be placed on this observation. It has been my inclination in many instances when dealing with an acute abdominal lesion in which the white count remains within normal, or even subnormal, limits to gauge the actual white cell count in terms of degree of infection by

placing three zeros after the number of staff forms and to consider that as the actual number of white blood cells. Thus, a total white cell count of 6000 with a staff count of 12 per cent would be considered a 12,000 leucocyte count. I feel this has frequently led me to operate in acute abdominal lesions when other findings were of no value in judging for or against operation. Of course, as stated before, this method is not infallible. Another factor which I believe is particularly helpful in evaluating the status of acute cholecystitis or its complications has been the "stationary loginess and apathy" which is usually manifested in those patients in whom other findings are not indicative of an advanced pathological state. A remaining shadow of the gall bladder or right upper quadrant haziness on a flat plate x-ray should also make one suspicious that all is not in order in the right upper quadrant even if all other signs, symptoms, and laboratory findings are within normal limits.

That age apparently plays a definite rôle in the mortality has previously been brought to our attention by Judd and by Heuer. In people over 50 years of age and especially those over 60 years of age, the tissues have less elasticity, and with the distention associated with cystic duct obstruction there is earlier and greater interference with the blood supply to the gall bladder. Then because the elasticity of the gall-bladder wall is also diminished, pressure gangrene or perforation with localized abscess or generalized peritonitis is very likely to occur quite early. It is in these elderly patients that the surgeon would like to delay operation, but analysis of most mortality tables reveals a much higher mortality for this group because of the greater incidence of gangrene, abscess, and perforation, and therefore this group actually needs serious surgical consideration.

Although cholecystectomy is the operation of choice in acute cholecystitis, it should not always be the operation of selection. Some authors are able to report a very high percentage of cholecystectomies but my own personal experience gives only 66⅔ per cent cholecystectomies and 33⅓ per cent cholecystostomies in the 24 patients operated upon. During the last several years, in cases of acute cholecystitis, I have been performing cholecystectomies more frequently by using the method of Thorek. The gall bladder is emptied with a trocar and suction after the operative field has been well packed off, and then is excised from the fundus down to the cystic duct on either side close to where it meets the liver surface. This portion of the gall bladder is removed and the mucosa remaining on the liver surface is then coagulated or cauterized with the electrocoagulating current or with phenol and alcohol. The cystic duct is ligated or drained with a catheter, and a running catgut suture is closed over the remaining gall-bladder mucosa on the liver surface. In my own patients, I insert a soft rubber drain (Penrose) down over the sutured gall-bladder bed to the cystic duct and right kidney area, bringing the drain out through a separate stab wound incision. Of course, in some cases the routine cholecystectomy technique may be used without additional difficulties.

The common duct may be opened directly for complete exploration of the duct, which I believe is the better method, or less preferably the cystic duct may be split down to its junction with the common duct. In neither acute nor chronic biliary conditions have I found it very satisfactory to explore the common duct through the cystic duct as the cystic ducts which I have encountered have usually been too small. If the common duct wall has been opened a T-tube is inserted. The arms of the T-tube should be shortened and bevelled, and a small piece of rubber should be removed from the transverse portion opposite the attachment of the long arm. If the common duct has been explored through the cystic duct, a catheter should be slipped through the cystic duct into the common duct. The common duct was opened in 6 or 25 per cent, of the 24 patients operated upon in my series and stones were found in 4 of these, or 16.6 per cent. In 1 of the 2 other cases, the delayed cholangiogram revealed a hepatic duct stone which could not be removed by the biliary flush because of its size. This patient succumbed at a secondary operation 3 months later. Choledochostomy was indicated in

several other cases because of the history of jaundice, but the condition of the patient or other difficulties did not warrant it at the time of operation. An argument against operation for acute cholecystitis is the ever present edema and advanced inflammation in the region of the common duct which makes its identification difficult. This is a logical argument when one is "common duct stone conscious," for about 90 per cent of all acute cholecystitis cases have stones within the gall bladder and probably 20 per cent of these will have stones in the common duct also. However, we sometimes have to choose the lesser of two evils. My faith in the biliary flush leads me to believe that it will probably answer the question in many of these cases retaining smaller common duct stones if it is used routinely following surgery.

If cholecystostomy is selected because of the general condition of the patient or because of fear of spreading toxic or infective elements, a large tube close to ½ inch in diameter, preferably with a flange such as a mushroom catheter with part of the base removed, is placed in the gall bladder. The smaller stones may pass out through the tube, and if necessary later, the gall bladder may be explored with the cystoscope as suggested by Hollenberg and Eikner. Little can be deduced from the mortality figures of cholecystostomy versus cholecystectomy, for the patient on whom cholecystostomy is done is usually more acutely ill and a poorer operative risk and naturally a higher death rate ensues.

On several occasions when the patient was moderately jaundiced at the time of operation but the common duct was not opened because of marked local edema and inflammation or because the patient's general condition was rather poor and no stone was grossly palpable, a thickened elongated cystic duct with or without stone was found bound down and angulated into the common duct in such a manner as to cause pressure on the common duct with probable partial obstruction. The cystic vessels seem to take part in this mechanism by acting as a bowstring holding the enlarged, thickened gall-bladder neck and cystic duct in a crowded position against the common duct. This probably is a definite entity and, although it explains some cases of jaundice, it does not definitely rule out common duct stone (Fig. 1).

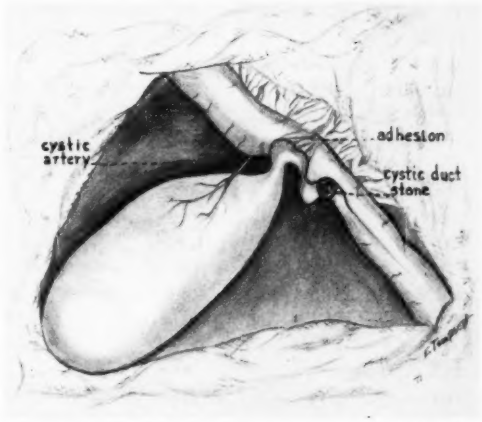


Fig. 1. The cystic vessels may act as a bowstring in acute cholecystitis and the enlarging, edematous cystic duct, with or without stone, become compressed against the common duct, causing partial to complete obstruction of the common duct.

In those cases in which the common duct has been opened and a T-tube or catheter inserted, it is most important that a delayed cholangiogram be made sometime around the seventh to tenth day, as one cannot search as diligently for stones in the common duct in the acute case as in the chronic case, and experience with cholangiography in chronic cases reveals the occasional finding of a remaining common duct stone. If a stone is portrayed, an attempt should be made to dislodge it with the routine 3 day biliary flush regimen and ductal irrigations as previously described.

If the stone is lodged above the T-tube in the hepatic duct, the T-tube should be removed so the stone can travel down to the lower end of the common duct. If the stone is too large to pass through the sphincter area an attempt should be made to break it up by instilling 5 cubic centimeters of a mixture of ⅔ ethyl ether and ⅓ ethyl alcohol into the common duct by the modified method of Pribham. Then if the cholangiogram reveals a disrupted stone, the flush should be repeated a number of times. In any event, after a tube or catheter has been removed, the patient

should be given the flush to wash out remaining débris.

A delayed cholangiogram should also be made in every case of cholecystostomy as it may give considerable information. For instance if the cholangiogram reveals a blocked cystic duct, the indwelling catheter should not be removed because, as the skin closes over, it leaves a blind mucosal pouch and one can anticipate a recurrence of the condition. If the cystic duct is blocked by edema rather than stone, hot packs together with warm saline and olive oil irrigations may cause the duct to become patent again. This can be ascertained by repeating the cholangiogram. If the cystic duct is blocked by a stone or if a stone is found in the gall bladder, an attempt may be made to break up the stone with the ether-alcohol mixture. Although I have never had particular success with this method there have been some encouraging reports on it. Another method for removing stone or stones remaining in the gall bladder is by means of the cystoscope, as described by Hollenberg and Eikner. Stones remaining in the gall bladder or a blocked cystic duct are indications for cholecystectomy.

Finally it must be stated that although a patent cystic duct with no stones remaining in the gall bladder favors no further recurrence of the gall bladder symptoms, we know that this is not assured and every patient who has a cholecystostomy for acute cholecystitis is a potential candidate for later cholecystectomy.

## SUMMARY AND CONCLUSIONS

1. The incidence of gangrene, abscess, and perforation in acute cholecystitis is between 10 and 30 per cent, and as in appendicitis the mortalities are mostly in this group. By approaching the case with a surgical attitude and deferring operation only when there is no confusion of signs, symptoms, laboratory findings, and appearance of the patient, the mortality for acute cholecystitis may be reduced.

2. The incidence of gangrene, abscess, and perforation is higher in the older age group, beginning with 50 years and especially after 60, and this group of cases carries the higher mortality rate. One should approach this group with a more definite surgical attitude.

3. In group 2 of my own series, in which all patients were approached with a definite surgical attitude, 72.8 per cent were operated upon early and only 13.6 per cent of the patients had advanced gangrene, abscess, or perforation. Only 1 death occurred in this group. In retrospect, in some of the patients operated upon the conditions might have subsided after 1 or 2 more days of observation. Probably about 50 per cent of cases of acute cholecystitis in any series should come to operation to give the lowest mortality for acute cholecystitis, but again it must be emphasized that any confusion of signs, symptoms, laboratory findings, including the haziness of the right upper quadrant in the flat x-ray plate, indicates a need for operation.

4. If the differential count reveals staff forms above 10 per cent, one should be suspicious of a nonsubsiding acute cholecystitis. In this group of cases, this was a fairly constant finding but not infallible.

5. As to appearance, a "stationary loginess or apathy," particularly in the older group, seemed to be a characteristic of nonsubsiding acute cholecystitis.

6. About 90 per cent of patients with acute cholecystitis have associated gall stones and about 20 per cent of these will have stones in the common duct. If the acute inflammatory reaction will subside, there is later a better opportunity to explore the common duct.

7. Probably it is safer to favor early operation and operate only upon about 50 per cent of the patients than to favor conservative treatment and operate only after advanced complications have arisen. In 2 groups of 22 patients each, the group mortality was reduced from 13.6 to 4.5 per cent by favoring early operation in about 70 per cent of the second group.

8. Delayed cholangiography when possible and the routine biliary flush are most important in the management of these cases.

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# HOW TO USE CATGUT

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THERE is one very real reason for writing on the use of catgut; namely, because the subject is so seldom dealt with in the literature except in a very fragmentary manner in textbooks. During the past 5 years, there has only been one article published on how to employ catgut to the best advantage, although there have been many articles on how to use silk. Catgut is the most widely used suture material, and the paucity of published comments undoubtedly accounts for its widespread poor usage and the confused ideas about this usage. Tradition still governs the employment of catgut, while knowledge regarding the process of wound healing has steadily advanced. In this paper, suggestions are made for improving the use of catgut based on the physiology of wound healing.

## THE SELECTION OF CHROMIC OR PLAIN CATGUT

Whether to use plain or chromic catgut can be decided only on the basis of the healing properties of tissues in which the sutures are to be employed. Chromic catgut is absorbed more slowly than plain and keeps its thread strength longer. Plain catgut, therefore, is used when rapid healing is to be expected, as occurs in serosa and mucosa covered surfaces, and for ligatures, because the blood clots quickly. For the very large arteries, however, chromic catgut must be used, for the proliferation of fibrous tissue is the only insurance against postoperative hemorrhage. Plain catgut is also indicated when the object of the suturing is only the obliteration of dead space to prevent "laking" of serum or blood. Dead space is found most frequently in muscle and fat.

Chromic catgut is used to suture those tissues which give immediate strength to the wound and which will maintain a sufficient amount of this strength to prevent separation of the cut edges until the time when the wound develops its own strength through the process of healing. Fortunately, those tissues which have the most holding power for sutures likewise develop the most strength during the healing of the wound. These are the fasciae, connective tissues of all descriptions, and the muscularis mucosae in the wall of the gastrointestinal tract.

## THE TISSUES WHICH TOLERATE CATGUT POORLY

Catgut should be used sparingly or not at all in those tissues which tolerate catgut poorly. The tissues which tolerate catgut poorly are: (1) the skin, (2) the subcutaneous fat, (3) mucous membranes, and (4) the muscles. The degree of toleration varies for each of these tissues and for different reasons.

The skin always harbors bacteria in the hair follicles regardless of the character and the amount of antiseptic used to cleanse its surface. Three or four days after catgut is inserted in the skin, these bacteria begin to grow around it. Inflammatory changes follow, and the strand is rapidly destroyed regardless of

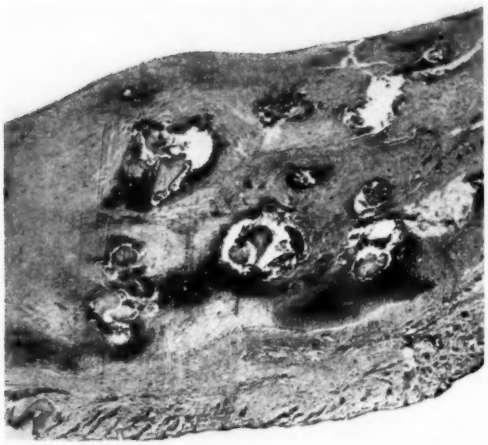

Fig. 1. Eight pieces of catgut in small area of tissue. (After Vivier.)

the size or degree of chromicization. Because of the tendency toward pus formation and premature absorption, catgut absolutely should not pierce the skin, although it may be used successfully as a subcuticular suture.

In the subcutaneous fat, the absorption of catgut, or more specifically the chemical and cellular reaction which brings about this absorption, tends to cause some necrosis, induration, and the elaboration of a small amount of serous exudate. The most common cause of induration of the wound sutured with catgut and of the escape of a small quantity of serous fluid on the tenth to the twelfth day of healing is the presence of too much catgut in the subcutaneous fat. Sutures in the subcutaneous fat contribute no strength to the wound anyway. If this layer is thick dead space will inevitably form, but obliteration of it can be accomplished in other ways which will not produce induration. The subcutaneous fascia may be sutured with very fine, small bite, interrupted sutures of plain catgut, No. 0000 or No. 00000, or tension sutures may be used. The fascia in the subcutaneous fat, even when invisible, can be easily located by means of rat-toothed forceps. These forceps pull out of the fat while they hold in the fascia.

Although wounds in mucous membranes heal rapidly, the earliest possible restoration of the continuity of their cut edges is desirable. As in the skin, this approximation creates an effective barrier against further bacterial contamination. However, mucous membranes slough where pierced by sutures unless they are extremely fine. Bower has shown that No. 00000 catgut is well adapted for suturing mucous membranes, yielding rapid primary healing with minimal tissue reaction. Unabsorbable sutures also slough from mucous membranes unless they are extremely fine. If they do not, permanent ulcerations are apt to remain about them where they penetrate the surface. Calculi form around unabsorbable strands extending through the mucous membrane of the gall bladder and urinary bladder.

Muscle tolerates catgut better than fat, but also tends to necrose and bleed easily—a tendency likewise exhibited toward unabsorbable sutures. Muscle possesses so little holding power for sutures anyway that the mechanical advantage gained hardly justifies the trauma of inserting them. Because of the lack of holding power, sutures frequently pull out of muscle within the first 4 days of healing. On the other hand, the sheaths of muscle should always be sutured, for they do possess holding power for sutures and do not necrose easily. When a large muscle bundle is cut across, interseptal fasciae should be sutured individually. For collapsing dead space in muscle, fine sizes, No. 000, of plain catgut will give the best result.

### HOW MUCH CATGUT SHOULD BE USED IN CLOSING A WOUND?

The best answer to the question of how much catgut should be used is, "Less than is generally thought to be required." Many of the untoward reactions exhibited by healing wounds sutured with catgut, the so called allergic and tissue hunger reactions, are really foreign body reactions caused by the use of excessive amounts of catgut. Catgut is used in such large sizes and in such large quantities that the tissues are simply overwhelmed. Edema and leucocytic invasion naturally occur, and the tissues thicken and become indurated. These changes can be seen in Figure 1, reproduced after Vivier. There are 8 pieces of catgut in a small area of tissue, and indeed the cross-sections of catgut are more apparent than the areas of tissue between.

In the suture of wounds, catgut is usually used abundantly because of two erroneous beliefs and a common fault in surgical technique. The first mistaken belief is that the larger sizes of sutures necessarily contribute the most strength to the wound, or in other words, it is not known how to obtain maximal strength with the least amount of suture material. The second is the erroneous belief that the complications of wound healing, such as disruptions, hematomas, and secondary hemorrhages, are avoided by suturing tissues as securely as possible in the manner used to tie inanimate objects. The fault in surgical technique is hurry.

The maximal strength of a wound is obtained with a minimal amount of suture material by suturing fasciae only, and by placing these sutures in such a manner that they pull at right angles to the major alinement of tissue fibers. This maximal strength cannot be reduced in amount unless the sutures employed have a knot or thread strength less than size No. 0, nor can it be increased by using sutures of larger sizes. In either case the holding power of the tissues for the sutures determines the strength of the wound. In tissues other than fasciae, finer sizes of catgut should be used. Because the holding power of the tissue for the suture determines the strength of the wound, the wound is strengthened by an increase in the number of sutures employed rather than in the size of the suture. However, no additional strength is provided by placing the sutures closer together than 1 centimeter (3).

Maximal strength of the wound is maintained by the use of interrupted sutures. If one interrupted suture breaks or sloughs out of the tissues, the others carry on their intended function. On the other hand, if a continuous suture is used, the entire strength of the wound is jeopardized when a break occurs anywhere along its length.

### COMPLICATIONS OF WOUND HEALING

Contrary to current belief, complications of wound healing are really reduced in number by decreasing the size of the catgut used within the limits stated. Increasing the quantity of catgut used and placing it needlessly in tissues where no important mechanical advantages result, tend to increase the amount of edema and exudative reaction, cause necrosis of tissue, decrease the holding power of the tissue for the sutures, weaken the thread strength of the catgut, and finally weaken the wound. Use of the larger sizes of catgut predisposes to wound infection, not only because the larger sizes provide a greater amount of foreign body in the wound, but also because the technique which is employed with them inevitably causes greater tissue destruction and provides a soil for the growth of bacteria. Hematomas become almost unknown when the finer sizes of catgut are used.

To prevent disruption of the laparotomy wound, the key tissue to suture properly is the posterior sheath of the rectus muscle. In the longitudinal incision of the anterior abdominal wall, the fibers of the posterior sheath are cut at right angles. Sutures placed in these cut edges pull out parallel to the fibers, and are consequently held insecurely. This sutured union, being the first defense against disrupting forces, separates in the first few days after operation and causes the disruption or a postoperative herniation depending on whether the outer layers give way also. To increase the strength of this layer, a mattress type of suture should be employed.

Hurry in suturing tissues necessitates the use of large needles which will not break and large sizes of catgut (Nos. 2 and 3) in long continuous strands. Large bites of tissue, i.e., greater than ½ centimeter, are taken and there is a greater tendency to tie tighter. In other words, the suture technique is the exact opposite of that employed with fine catgut and therefore results in a greater number of wound complications.

### HOW TO PREVENT BACTERIAL CONTAMINATION OF CATGUT

Although sterile when placed on the operating table, catgut sutures often become contaminated with bacteria by the time they are tied in the tissues. These bacteria come from the air, and more commonly from the tissues and blood of the wound. Regardless of the type of antiseptic used, bacteria can be grown with surprising regularity from the first blood entering the

wound after the skin has been cut. Whether the tissues can resist these relatively harmless bacteria depends in part on the amount of foreign body present in the wound. All sutures are foreign bodies and, therefore, a reduction of the quantity of suture material used decreases the possibility that the bacteria will gain a foothold. The minimizing of trauma caused by their insertion decreases the amount of contused tissue present, and contused tissue is not only a foreign body but a growth medium for the bacteria, thereby predisposing to infection. Contact with exposed skin, repeated soiling with serum such as occurs when ligatures are taken from a spool, and contact with linen or instruments which have been in the operative field are all sources of contamination which should be avoided during an operation. In too many instances improper sterilization of catgut during preparation is given as the cause of wound infections, whereas the faults are actually those of surgical technique.

### CATGUT AND CONTAMINATED WOUNDS

Catgut is overwhelmingly the suture of choice in contaminated wounds. Kocher, in spite of his preference for silk for clean wounds, did not hesitate to use catgut in contaminated wounds. Halsted never discussed this point in any of his writings, except to say that if an infection developed with silk there would probably be little trouble if the silk were fine enough. Only Shambaugh and Dunphy have come out strongly for the use of silk in contaminated wounds on the basis that the duration of infection with silk is no longer than with catgut. However, in many of the cases repaired with silk, the sutures were mechanically removed and, unfortunately, offending silk stitches are not always available for mechanical removal.

When catgut is used to repair a freshly contaminated wound made to drain an infected focus, such as an abscess in the peritoneal cavity, the spirit of "contaminated anyway" usually dominates the technique. Only infrequently is a half-hearted attempt made to have the catgut reach its final location with a minimal amount of bacterial contamination. Instead, the sutures are used to inoculate the bacteria deep into tissues where the ordinary seepage along a drainage tract would never place them. To prevent this catastrophe, four suggestions are offered for the management of this type of wound: (1) The edges of the wound should be well walled off with laparotomy pads before the peritoneum is opened. (2) The pus should be removed by suction and not allowed to flow over the wound edges. (3) The drain should be placed at one end of the wound. (4) After the peritoneum is closed, the wound is irrigated, débrided, redraped, and treated just like any contaminated traumatic wound. With this technique, catgut sutures can be inserted into the tissues with little or no bacterial contamination.

### THE OBJECT OF THE USE OF CATGUT

The object of all suturing is to allow the cells to regenerate between the cut edges and thus restore the continuity of the wound. The work of Ravdin, Thompson, et al (7), showing that fibroblasts appear late, proliferate slowly, and that the wound disrupts whether sutured with catgut or silk in the presence of hypoproteinemia, illustrates the ultimate uselessness of sutures if cells do not regenerate. Ingalls, et al. (5), have shown that wounds heal poorly and disrupt regardless of the type of suture material used if there is a C-avitaminosis because fibroplasia is distorted. The failure of cells to regenerate properly, therefore, should not be caused by the sutures themselves. The object of their use is thereby nullified. Infection in wounds, necrotic tissue, and excessive amounts of foreign bodies retard the growth of cells, and all these changes can be produced by sutures. The size of the suture, and its method of use are the important factors to be considered. "Think of the cells" is the best of all possible maxims for the use of sutures, and more attention should be given to their use to improve the results of wound healing.

### SUMMARY

This article is purely a plea for the better use of the catgut suture. The following points have been emphasized:

1. The selection of plain or chromic catgut is determined by the rate of healing of the tissue in which the suture is to be used.

2. Catgut is tolerated poorly in skin, subcutaneous fat, mucous membranes, and muscles.

3. Maximal strength of the wound is obtained by the use of sutures in the fascia when they pull at right angles to the fibers. Maximal strength is maintained by the use of interrupted sutures.

4. Complications of wound healing are reduced in number by decreasing the size of the catgut used. No catgut suture larger than No. o need be used in fascia; No. ooo in muscle, No. oooo in subcutaneous fascia, and No. ooooo in mucous membranes. In order to prevent wound disruption and postoperative hernia, the key tissue to be sutured in the laparotomy wound is the posterior sheath of the rectus muscle.

5. In the repair of clean wounds, catgut sutures are often needlessly contaminated by unsuspected faults in surgical technique.

6. Whether tissues will resist bacterial infection or not depends on the amount of foreign body and necrotic tissue present in a wound, and since all sutures are foreign bodies and are capable of producing necrotic tissue by their misuse, a reduction in the quantity of catgut employed and the adoption of the careful technique required for the finer sizes decrease the opportunity for infection.

7. In contaminated wounds catgut is the suture material of choice, but seldom is an effort made to prevent its contamination. Four suggestions are offered to prevent contamination of the suture in the repair of the wound made clean to drain an infected focus in the peritoneal cavity.

8. The object of all suturing is to allow cells to regenerate. All types of sutures are useless when cells fail to regenerate for other reasons, but certainly neither the sutures nor their method of use should be made the cause of this failure.

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# THE PROPHYLACTIC IMPLANTATION OF SULFANILAMIDE IN CLEAN OPERATIVE WOUNDS FOR THE REDUCTION OF POSTOPERATIVE INFECTIONS

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MOST surgeons will agree with the statement that every operative incision is potentially an infected wound. This is one of the unsolved problems of surgery, and the possibility of postoperative infection not infrequently causes the surgeon to advise against an operation which, in his opinion, would be beneficial to the patient but is hardly worth the risk involved. This is particularly true in the treatment of fractures when the surgeon is often content with a fair result obtained by manipulative means or traction when by open operation he could have obtained a more perfect result with much less effort.

So important is the question of postoperative infection that the American College of Surgeons in 1940 devoted one symposium to the subject (Meleney, 9) and another symposium to sterilization and aseptic operative room technique (Cutler, 1). We do not know just what percentage of our own clean operative wounds have become infected in the past. We can recall surgical tragedies in which the result of an apparently satisfactory operation was ruined by infection, and in one instance the patient died. We believe that between 1 and 2 per cent of our clean operative wounds have developed an infection sufficiently serious to cause a portion of the wound to be opened and drained. It is probable, however, that the percentage is higher, as Meleney (8) states that impressions in regard to the incidence of postoperative infections are woefully inaccurate.

Not only do infections occur, but in our experience attempts to trace the source of the infection have nearly always resulted in failure. An exception was on January 14, 1932, when both of 2 clean cases in which operation had been done the same morning became infected. One was a knee from which a semilunar cartilage was removed and the other was a patient with Paget's disease in whom a long section of the tibia was removed for the relief of intractable pain. In each instance the infecting organism was a hemolytic streptococcus and the day after the operation a member of the operating team entered the hospital with a streptococcic throat and the organisms from the wound and from the throat seemed to be identical. At that time, folded gauze masks were used. As a result of that experience, large heavy muslin masks were adopted and during the past few years these have usually contained a sheet of cellophane and have been fitted with a strip of aluminum which is bent over the bridge of the nose. However, in spite of this improvement in the type of masks used, we have still had occasional postoperative infections.

As a result of a careful 9 year study, the surgical service of the Presbyterian Hospital in New York City was able to reduce the incidence of postoperative infections from 14 per cent in 1925 to 4.8 per cent in 1933. It is to be noted that of the patients operated upon in 1925, 4 per cent developed serious infections and 10 per cent developed trivial infections, while in 1933 1.1 per cent developed serious infections and 3.6 per cent developed trivial infections. Meleney (8), in his report of this study, indicated that the work would be continued and in his second report (Meleney, 9) it is shown that in 1939 the incidence of serious infection was 0.6 per cent and of trivial infection was 2.6 per cent. Meleney suggests ways and means of minimizing postoperative infections and emphasizes particularly sufficient autoclaving and proper masking of the nose

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and mouth of the operating personnel. He also lays stress on the advantage of fine silk over catgut as suture and ligature material and mentions the fact that the operating room personnel have become infection-conscious. It is our belief that this last is probably the most important single factor in the reduction of postoperative infection.

Hart, in a brief review of his experience with the use of ultraviolet radiation as a method of sterilizing the air in the operating room at the Duke Hospital, stated that as a result of this change in technique the incidence of infection in that hospital has been reduced from an average of 4 per cent in clean primary incisions of small magnitude to considerably less than 1 per cent in a series of extensive operations in which the ultraviolet radiation was used.

It is evident from Hart's report and from his numerous papers on the subject that he believes that most operative infections are due to contamination of the air in the operating room, and he attributes the reduction in postoperative infection to the relative sterilization of this air and to the killing of bacteria which may have settled on the dressings and instruments or on the surface of the wound. From his writings there is no question but that the introduction of ultraviolet radiation into the operating rooms has been followed by improvement in the results obtained by the surgeons in that hospital. However, here, too, the fact that the presence of the radiation has rendered the surgical staff infection-conscious must be considered and may be a factor in the reduction of the number of postoperative infections. At any rate, the results at the Presbyterian Hospital as reported by Meleney and at the Duke Hospital as reported by Hart with radiation are comparable, although they attribute their improvement in results to entirely different procedures.

On May 26, 1939, we performed a cup arthroplasty of the hip on a patient with bony ankylosis of both hips. Infection developed in the wound and eventually the cup was removed. The final result was a recurrence of the ankylosis in a somewhat more satisfactory position. At that time we had been impressed by the results obtained by Jensen, Johnsrud and Nelson in the treatment of compound fractures by the implantation of sulfanilamide powder in the wound and we had used this method in compound fractures and other contaminated or potentially infected wounds. We had also performed a number of animal experiments which had convinced us that the presence of the sulfanilamide did not materially interfere with the healing of the soft tissues of the wound and that it did not appreciably interfere with the union of fractures in experimental animals. (Key et al., 4, 5, 6, 7).

As a result of the experience with this arthroplasty, we began implanting sulfanilamide in the wounds of our more serious operative cases. The results following the implantation of sulfanilamide in the larger operative wounds were so satisfactory that we gradually increased the frequency with which we have used the drug until at the present time sulfanilamide powder is routinely implanted in all of our clean operative wounds before the wound is sutured.

Since May 26, 1939, only 3 patients on whom one of us (J. A. K.) has operated and sutured the wound have developed a postoperative infection. Two of these were in wounds which were not really clean but were in old infected compound fractures which were operated upon relatively soon after the sinuses had closed. These developed low grade infections about 10 days after the operation and drained for a few weeks and then healed. They were the only two of a group of cases operated upon at the Missouri Pacific Hospital which developed an infection and are not included in this series of 150 patients who were all operated upon at the Barnes and the Jewish Hospitals.

Of the patients operated upon at the Barnes Hospital, there were no postoperative infections in the usual sense of the term, but the third case mentioned occurred in a boy (Case 82, Table I) 4 years of age from whom a large lymphangioma had been removed from the anterior and mesial portions of the thigh. The wounds healed by primary intention and the sutures were removed and a pressure dressing was applied. The boy was discharged to his home in Springfield, Illinois, on the tenth day after the operation. There the dressing

was removed and he developed a swelling on the front of the thigh and fever. He returned to the hospital 8 days after discharge with a large fluctuant swelling on the front of the thigh. A hemostat was pushed through the paper-thin operative scar and about 100 cubic centimeters of clear fluid was evacuated. Sulfanilamide powder was placed in the cavity and the patient made an uneventful recovery and returned to his home 10 days later.

In another patient (Case 61, Table I) the lower portion of the wound in the back was opened on the third postoperative day because an infection was feared. No infection was present and it was determined later that an infection and retention of urine in the bladder accounted for the patient's temperature. This patient later developed a bed sore which led to a low grade infection in the wound.

Among the patients operated upon at the Jewish Hospital during this period, there have been no postoperative infections or complications such as the 2 mentioned.

Naturally, the question arises as to whether or not the local implantation of sulfanilamide powder in the wound is dangerous to the patient. In order to answer the various objections which have been raised to the method, we are, in this paper, recording observations on 150 almost consecutive operations of various types. These operations were all performed by one surgeon (J. A. K.). They were performed in two hospitals under conditions which exist in the general surgery operating room in the average good hospital. They were performed with frequently changing personnel of assistant residents, internes, and nurses. The air in the operating room was not conditioned and no appreciable change in technique has been made from that followed in the past. For the most part, silk was used for ligatures and sutures. The surgery was as atraumatic as was consistent with the skill of the operator. Care was taken not to tie the sutures too tightly and to leave as few buried sutures and ligatures as was consistent with adequate closure and hemostasis. In some instances the skin has been closed with catgut when prolonged immobilization in a plaster cast was indicated and when it was not desirable to change or to cut a window in the plaster. In other instances sutures of chromic catgut have been placed where it was deemed a disadvantage that the sutures be permanent, as in closing the muscles after a spinal fusion. The skin has been protected by skin towels in about half of the cases; that is, in most of the major cases in which the application of the towels would not interfere with the operation. The skin preparation has been as follows:

The patient entered the hospital the day before the operation in most instances. The extremity was scrubbed with soap and water and shaved. It was then scrubbed with alcohol. In certain instances it was painted with tincture of merthiolate or mercresin the day before the operation. No sterile dressing was applied. After the patient had been placed on the operating table, the field of the operation was scrubbed with alcohol or ether, and painted with tincture of merthiolate or tincture of mercresin.

In Tables I and II are listed a series of 150 almost consecutive clean operations in which sulfanilamide powder was implanted in the wound. The maximum rise in temperature after the operation, the character of healing of the wound and the length of stay in the hospital after the operation are given in the tables. It is to be noted that the hospital stay varies greatly, even in operations of the same type. This is because most of these patients were private patients, and their stay in the hospital was regulated largely by their economic status. For instance, Case 66 and Case 69 were 2 patients operated upon on the same day for nonunion of fracture of the hip, by McMurray's oblique osteotomy. One patient went home on the tenth day after the operation in a plaster-of-Paris cast and convalesced at home. The other patient remained in the hospital for 118 days, until she was walking well on crutches. Both wounds healed *per primam* with no complications.

## ANALYSIS OF CASES

*Rationale of the procedure.* When sulfanilamide powder is placed in the wound, this powder becomes dissolved in the fluid which collects in the wound and this fluid is then a saturated solution of the drug, if an excess of the drug is available, and 1 gram of the drug

TABLE I.—RÉSUMÉ OF 110 CASES IN WHICH SULFANILAMIDE WAS PLACED IN WOUNDS AFTER OPERATION—BARNES HOSPITAL

| Case No. | Hospital No. | Diagnosis | Operation | Anesthesia | Post-operative temperature degrees C. | Post-operative days in hospital | Healing |
|---|---|---|---|---|---|---|---|
| 1 | 75904 | Chronic sacro-iliac strain, left | Sacro-iliac fusion | G | 38.1 | 15 | P |
| 2 | 56360 | Healed fracture tuberosity os calcis | Removal of nail | L | 37 | 1 | P |
| 3 | 75870 | Disorganization of hip joint left | Shelf operation | G | 38 | 11 | P |
| 4 | 75467 | Chronic arthritis right sternoclavicular joint | Biopsy of clavicle and joint | G | 37.6 | 10 | P |
| 5 | 68553 | Metastatic fibrosarcoma right inguinal nodes | Excision lymph nodes | G | 37.2 | 6 | P |
| 6 | 75051 | Psoriasis arthropathica | Synovectomy right knee | G | 37.6 | 11 | P |
| 7 | 76604 | Osteoid osteoma of tibia | Excision | G | 37.8 | 7 | P |
| 8 | 75761 | Deformity of left foot, post-traumatic | Reconstruction of foot | G | 37.2 | 8 | P |
| 9 | 73406 | Old fracture vertebrae, 4th and 5th lumbar | Lumbosacral fusion | L | 38.5 | 19 | P |
| 10 | 75177 | Diabetes mellitus. Suppurative arthritis left knee. Arteriosclerotic gangrene left foot | Midthigh amputation | G | 38.1 | 18 | P |
| 11 | 75664 | Bilateral hallux valgus | Silver operation. Bilateral | L | 37.8 | 9 | P |
| 12 | 78382 | Paralysis of ulnar nerve | Ulnar nerve transposition | G | 37.4 | 3 | P |
| 13 | 78431 | Subluxation of navicular and lunate bones of hand | Removal of navicular and lunate bones of hand | G | 37.5 | 3 | P |
| 14 | 79125 | Bilateral hallux valgus | Keller operation | L | 37.8 | 12 | P |
| 15 | 79189 | Comminuted fracture dislocation right humerus | Open reduction and wiring | L | 37.9 | 8 | P |
| 16 | 79261 | Torn internal semilunar cartilage | Excision of cartilage | G | 37.8 | 6 | P |
| 17 | 79431 | Fracture of ulna and radius, left | Open reduction and wiring | G | 38 | 8 | P |
| 18 | 81852 | Comminuted T fracture of humerus | Open reduction and wiring | G | 38.1 | 30 | P |
| 19 | 82696 | Fracture of olecranon | Open reduction and wiring | G | 37.5 | 9 | P |
| 20 | 82528 | Traumatic arthritis ankle joint, left | Arthrodesis of ankle | G | 38 | 15 | P |
| 21 | 82415 | Subdeltoid bursitis | Excision bursal lining | G | 37.5 | 8 | P |
| 22 | 29491 | Fracture of ulna and radius, left | Open reduction | G | 38 | 5 | P |
| 23 | 80266 | Hallux valgus, bilateral | Keller operation | L | 37.5 | 8 | P |
| 24 | 80318 | T fracture of humerus | Open reduction and wiring | G | 38 | 5 | P |
| 25 | 32994 | Old osteomyelitis of tibia, right | Midleg amputation | G | 37.4 | 20 | P |
| 26 | 80455 | Loose body, left knee joint | Removal of loose body | L | 37.5 | 7 | P |
| 27 | 80499 | Fracture olecranon, left | Open reduction and wiring | G | 37.4 | 15 | P |
| 28 | 68359 | Old osteomyelitis, left tibia | Amputation left leg at knee | G | 37.4 | 15 | P |
| 29 | 81023 | Chondrosarcoma clavicle, right | Removal of clavicle | G | 38.1 | 10 | P |
| 30 | A4824 | Osteoid osteoma of tibia | Excision osteoma of tibia | G | 38 | 16 | P |
| 31 | 68889 | Osteoid osteoma of fibula | Excision, osteoma of fibula | G | 37.8 | 4 | P |
| 32 | 61156 | Chronic osteoarthritis of hip | Cup arthroplasty | G | 37 | 32 | P |
| 33 | 80310 | Coccygodynia. Pilonidal cyst | Excision of coccyx. Excision of cyst | L | 38 | 12 | P |
| 34 | 46780 | Familial osseous atrophy of feet with osteomyelitis of right foot | Amputation, right leg | G | 38 | 16 | P |
| 35 | A4829 | Old pyogenic arthritis, right knee | Arthroplasty of knee | G | 39.4 | 42 | P |
| 36 | 84331 | Spondylolisthesis | Lumbosacral fusion | L | 38.4 | 21 | P |
| 37 | 84375 | Fracture tibia and fibula | Open reduction and nailing condyle Excision external semilunar cartilage | G | 37.8 | 5 | P |

P, primary healing. G, general and L, local anesthesia.

TABLE I.—RÉSUMÉ OF 110 CASES IN WHICH SULFANILAMIDE WAS PLACED IN WOUNDS AFTER OPERATION—BARNES HOSPITAL—Continued

| Case No. | Hospital No. | Diagnosis | Operation | Anesthesia | Post-operative temperature degrees C. | Post-operative days in hospital | Healing |
|---|---|---|---|---|---|---|---|
| 38 | 84547 | Hallux valgus | Keller operation | L | 37.2 | 10 | P |
| 39 | 84460 | Compound and simple comminuted fracture of tibia and fibula | Open reduction and plating | G | 37.5 | 12 | P |
| 40 | 89158 | Tuberculosis of spine | Spinal fusion | L | 38.4 | 12 | P |
| 41 | 84139 | Osteochondritis of tibial tubercle | Drilling of tubercle | L | 37.6 | 1 | P |
| 42 | 83935 | Fracture greater tuberosity of humerus | Open reduction and nailing | L | 37.8 | 14 | P |
| 43 | 84005 | Flail elbow | Revision of elbow | G | 38.6 | 2 | P |
| 44 | 83301 | Fracture of olecranon | Open reduction and wiring | G | 37.3 | 5 | P |
| 45 | 65118 | Traumatic synovitis left knee | Exploration of knee | G | 38.5 | 13 | P |
| 46 | 84689 | Fracture of olecranon | Open reduction and wiring | G | 37.9 | 5 | P |
| 47 | A8977 | Comminuted fracture of humerus | Open reduction and wiring | G | 38.3 | 6 | P |
| 48 | A9033 | Chronic hydrarthrosis, right knee | Synovectomy | G | 38 | 5 | P |
| 49 | A8570 | Internal derangement of left knee | Excision both semilunar cartilages and of exostosis of tibia | G | 37.6 | 24 | P |
| 50 | 85350 | Fracture of radius and ulna | Open reduction and wiring | G | 37.8 | 2 | P |
| 51 | 86029 | Hallux valgus with hammer toe, bilateral | Excision 4 metatarsal heads and Keller operation | G | 37.9 | 10 | P |
| 52 | 86105 | Old traumatic diastasis of ankle joint | Reconstruction of ankle and wiring malleoli | G | 37.8 | 12 | P |
| 53 | 76420 | Contracture of forearm muscles | Tenolysis of flexor tendons | G | 38.1 | 5 | P |
| 54 | 85542 | Fracture of olecranon | Open reduction and wiring | G | 38.5 | 3 | P |
| 55 | 71762 | Chronic anterior subluxation of shoulder | Tendon sling to humeral head and plication of capsule | G | 39.2 | 9 | P |
| 56 | 85271 | T fracture of humerus | Open reduction and wiring | G | 38.1 | 4 | P |
| 57 | 85164 | Fracture head of radius | Removal head of radius | G | 37.8 | 3 | P |
| 58 | 75051 | Psoriatic arthritis of knee, left | Synovectomy | G | 38 | 9 | P |
| 59 | A9636 | Osteoarthritis of hip | McMurray osteotomy of femur | G | 37.8 | 85 | P |
| 60 | A10098 | Transverse comminuted fracture, neck of humerus | Open reduction and wiring | G | 38 | 26 | P |
| *61 | A10399 | Spondylolisthesis | Lumbosacral fusion | L | 39.8 | 24 | P* |
| 62 | A10115 | Comminuted fracture, right patella | Excision of patella | G | 37.8 | 31 | P |
| 63 | 71067 | Hallux valgus, bilateral | Operation for hammer toe and Keller operation, bilateral | G | 37.4 | 9 | P |
| 64 | 83364 | Chronic subdeltoid bursitis, bilateral | Excision of bursal lining, bilateral | L | 37.5 | 7 | P |
| 65 | 84140 | Osgood-Schlatter's disease, bilateral | Drilling of tibial tubercles | L | 37.6 | 1 | P |
| 66 | 82283 | Old fracture of femoral neck with nonunion | McMurray osteotomy of femur | G | 37.9 | 10 | P |
| 67 | 83808 | Chronic tenosynovitis of thumb | Lysis of adhesions and opening of tendon sheaths | L | 37.2 | 2 | P |
| 68 | 82982 | Joint mice elbow, posttraumatic | Exploration of elbow with removal of joint mice | G | 38 | 9 | P |
| 69 | 82277 | Fracture of femoral neck with nonunion | McMurray osteotomy of femur | G | 38 | 118 | P |
| 70 | 28434 | Osteochondroma of sternum | Excision | L | 37.3 | 4 | P |
| 71 | 58211 | Calcification over trochanter<br>Spur, os calcis | Excision<br>Excision | G | 38.4 | 9 | P |
| 72 | 21441 | Old tuberculosis of knee | Arthrodesis of knee | G | 37.8 | 18 | P |
| 73 | 67840 | Old gunshot wound of foot | Triple arthrodesis of foot | G | 38 | 6 | P |

P, primary healing; *complications, explained in text.

TABLE I.—RÉSUMÉ OF 110 CASES IN WHICH SULFANILAMIDE WAS PLACED IN WOUNDS AFTER OPERATION—BARNES HOSPITAL—Concluded

| Case No. | Hospital No. | Diagnosis | Operation | Anesthesia | Post-operative temperature degrees C. | Post-operative days in hospital | Healing |
|---|---|---|---|---|---|---|---|
| 74 | 81730 | Coccygodynia | Excision of coccyx | G | 37.4 | 10 | P |
| 75 | 79218 | Progressive muscular atrophy with unstable ankle | Triple arthrodesis and Campbell block | G | 38 | 14 | P |
| 76 | 81295 | Coccygodynia | Excision of coccyx | G | 38.2 | 8 | P |
| 77 | P1394 | Volkmann's contracture | Reconstruction of forearm | G | 37.8 | 9 | P |
| 78 | P1554 | Congenital torticollis | Lengthening of sternomastoid and deep fascia | G | 38.5 | 2 | P |
| 79 | Q2451 | Cyst, neck of femur | Osteotomy | G | 38.4 | 9 | P |
| 80 | Q2229 | Fracture, head of radius | Open reduction | G | 38.4 | 2 | P |
| 81 | Q1014 | Congenital torticollis | Lengthening of sternomastoid and dee fascia | G | 37.6 | 5 | P |
| *82 | Q1716 | Lymphangioma of thigh | Excision of tumor | G | 38 | 10 | P* |
| 83 | J1603 | Spastic paralysis | Popliteal neurectomy. Lengthening heel cord. Triple arthrodesis | G | 39.2 | 7 | P |
| 84 | K1272 | Talipes equino varus | Stabilization of foot. Lengthening heel cord | G | 38.6 | 9 | P |
| 85 | G1453 | Congenital pseudoarthrosis | Double bone graft, tibia | G | 38.1 | 7 | P |
| 86 | J2243 | Old fracture, right femur | Epiphyseal arrest at knee, left | G | 37.8 | 8 | P |
| 87 | Q888 | Osteochondroma and deformity of radius | Osteotomy of radius and ulna | G | 38.4 | 3 | P |
| 88 | 81034 | Fracture of leg with nonunion | Step operation | L | 38.2 | 14 | P |
| 89 | 70148 | Fracture of femur with nonunion | Onlay graft to femur | G | 38 | 37 | P |
| 90 | 78714 | Fracture of femur | Open reduction and wiring | G | 38.4 | 31 | P |
| 91 | 77795 | Internal derangement of knee | Excision of semilunar cartilages of knee | G | 38 | 11 | P |
| 92 | 81752 | Hallux valgus, bilateral, with hammer toes | Operation for hallux valgus and hammer toes. Lengthening heel cord | G | 37.8 | 8 | P |
| 93 | 77675 | Internal derangement of knee joint | Excision of semilunar cartilages and reconstruction of both lateral ligaments | G | 38.6 | 11 | P |
| 94 | 77589 | Old fracture femoral neck | Colonna reconstruction of hip | G | 38.4 | 44 | P |
| 95 | 76711 | Old fracture femoral neck | Colonna reconstruction of hip | G | 37.9 | 50 | P |
| 96 | 77637 | Fracture of head of radius | Resection of head of radius | G | 38.3 | 3 | P |
| 97 | 72619 | Chronic sacroiliac strain | Sacroiliac fusion | G | 38.4 | 12 | P |
| 98 | 75626 | Scar of deep muscles of thigh | Removal of scar tissue and lysis of adhesions | G | 37.9 | 11 | P |
| 99 | 75570 | Congenital dislocation of hip | Shelf operation | G | 38.5 | 6 | P |
| 100 | 45783 | Chronic olecranon bursitis | Excision of bursa | L | 37.3 | 1 | P |
| 101 | 84439 | Arthritis, left ankle joint | Arthrodesis of ankle | G | 38.1 | 14 | P |
| 102 | B197 | Subdeltoid bursitis, right | Excision of bursa | L | 37.5 | 2 | P |
| 103 | B242 | Recurrent dislocation of shoulder | Modified Nicola operation | G | 38.3 | 17 | P |
| 104 | B581 | Sarcoma of clavicle | Excision of clavicle and tumor | G | 38 | 10 | P |
| 105 | 75837 | Interdigital clavus | Excision of exostosis and osteotomy of phalanges | L | 37.4 | 3 | P |
| 106 | 84449 | Fracture of femoral neck | Nailing of hip | L | 38.2 | 19 | P |
| 107 | B328 | Fractured patella, old | Wiring and lengthening of quadriceps | G | 38.4 | 10 | P |
| 108 | B221 | Fracture of femoral neck | Nailing of hip | G | 38.6 | 28 | P |
| 109 | E36903 | Old septic hip | McMurray's osteotomy and transplant of trochanter | G | 38.5 | 19 | P |
| 110 | B287 | Subdeltoid bursitis | Excision of subdeltoid bursa | L | 37.6 | 3 | P |

P, Primary healing; *Complications, explained in text.

TABLE II.—RÉSUMÉ OF 40 CASES IN WHICH SULFANILAMIDE WAS PLACED IN WOUND AFTER OPERATION—JEWISH HOSPITAL

| Case No. | Hospital No. | Diagnosis | Operation | Anesthesia | Post-operative temperature degrees F. | Post-operative days in hospital | Healing |
|---|---|---|---|---|---|---|---|
| 1 | 250972 | Tear internal semilunar cartilage | Excision of cartilage | G | 100.2 | 11 | P |
| 2 | 113402 | Recurrent dislocation of patella | Hitchcock operation | G | 100 | 14 | P |
| 3 | 401860 | Torn internal semilunar cartilage | Excision of cartilage | G | 101.8 | 6 | P |
| 4 | 401879 | Nonunion of tibia | Multiple drilling | L | 99.4 | 10 | P |
| 5 | 401848 | Fracture, left radius | Open reduction | G | 100.2 | 2 | P |
| 6 | 301718 | Fracture, left radius | Open reduction | G | 99 | 4 | P |
| 7 | 401867 | Hallux valgus, bilateral | Bilateral Keller operation | G | 101 | 9 | P |
| 8 | 401863 | Torn internal semilunar cartilage | Excision of cartilage | G | 99.2 | 4 | P |
| 9 | 401861 | Cyst of external semilunar cartilage | Excision of cartilage | G | 98.8 | 11 | P |
| 10 | 402526 | Nonunion of femur | Step operation | G | 101 | 112 | P |
| 11 | 270033 | Sciatic pain | Ober fasciotomy | G | 99.8 | 9 | P |
| 12 | 262586 | Old fracture of olecranon | Wire and autogenous bone peg | G | 102 | 4 | P |
| 13 | 401844 | Osteoid osteoma astragalus | Excision | G | 100 | 7 | P |
| 14 | 261318 | Subdeltoid bursitis | Excision bursal lining | G | 99 | 7 | P |
| 15 | 401874 | Rupture long head of biceps | Suture to coracoid | G | 100 | 6 | P |
| 16 | 400602 | Calcification over internal condyle of femur | Excision of calcified area | L | 100.5 | 8 | P |
| 17 | 401866 | Hallux valgus, bilateral | Bilateral Keller operation | L | 99.5 | 7 | P |
| 18 | 401864 | Sciatic pain | Ober fasciotomy | G | 100 | 8 | P |
| 19 | 401862 | Tear of internal semilunar cartilage | Excision of cartilage | G | 101 | 5 | P |
| 20 | 402119 | Tear of internal semilunar cartilage | Excision of cartilage | L | 100.5 | 11 | P |
| 21 | 330590 | Osteochondroma of scapula | Excision | G | 99.4 | 5 | P |
| 22 | 340042 | Coccygodynia | Excision of coccyx | G | 99.6 | 7 | P |
| 23 | 113530 | Low back and sciatic pain | Fusion, right sacroiliac and Ober fasciotomy | G | 102 | 30 | P |
| 24 | 401845 | Old fracture of patella | Wiring of freshened fragments | G | 100.2 | 21 | P |
| 25 | 114907 | Sciatic pain | Fasciotomy | G | 99.2 | 9 | P |
| 26 | 113482 | Fracture of patella | Excision, distal fragment and silk suture | G | 101 | 18 | P |
| 27 | 113148 | Spondylolisthesis | Lumbosacral fusion | L | 100.4 | 21 | P |
| 28 | 114225 | Fracture, radius | Open reduction | G | 100.6 | 5 | P |
| 29 | 114642 | Ankylosis of wrist in flexion | Osteotomy | G | 99.6 | 2 | P |
| 30 | 402752 | Fracture, condyle of tibia | Nailing condyle. Excision, external semilunar cartilage | G | 100.6 | 10 | P |
| 31 | 115039 | Internal derangement of knee | Excision, external semilunar cartilage—Mauck operation | G | 101 | 12 | P |
| 32 | 115636 | Old Colles fracture | Campbell's operation | G | 100.5 | 7 | P |
| 33 | 115582 | Tear of internal semilunar cartilage | Excision of cartilage | G | 101 | 7 | P |
| 34 | 401855 | Hammer toe | Hammer toe operation | L | 99 | 1 | P |
| 35 | 401873 | Subdeltoid bursitis | Excision of bursa | L | 100.4 | 5 | P |
| 36 | 331570 | Sesamoiditis | Excision of sesamoids | L | 100 | 10 | P |
| 37 | 401850 | Fracture, right hip | Nailing of hip | L | 102.4 | 120 | P |
| 38 | 250007 | Fibrocystic disease of tibia | Excision of fibroma and bone chips | G | 100.6 | 17 | P |
| 39 | 115945 | Fracture, both bones of forearm | Open reduction and wiring | G | 102.4 | 7 | P |
| 40 | 116313 | Osteochondroma of tibia | Excision of tumor | G | 100.3 | 7 | P |

P, Primary healing.

will saturate approximately 100 cubic centimeters of fluid. It has been shown by us and by other observers in the literature, which has been reviewed in a previous paper (7), that a saturated solution of sulfanilamide crystals not only inhibits the growth of strains of streptococci which are susceptible to the drug in dilute solutions, but also inhibits the growth of staphylococci and of gas bacilli and of other organisms which are not susceptible to the drug in dilute solutions. It has further been shown that the efficiency of the drug varies inversely with the number of organisms present. Consequently, in a clean operative wound which is contaminated by relatively few pathogenic organisms, the situation should be ideal for the inhibition of the growth of these organisms by the drug to a point where the defense mechanism of the patient can destroy the contaminating bacteria.

The sulfanilamide powder remains in the wound for about 48 hours and it not only saturates the fluid in the wound, but it diffuses into the surrounding tissues.

In placing the powder in clean operative wounds, much less of the drug is used than is used in contaminated wounds. In the beginning some of our wounds developed an excess of serum in the wound and we believe that this was, in part, due to the presence of too much powder. As our experience with the method has increased, we have reduced the amount of the drug until now we rarely put more than 5 grams in a single wound, the amount depending upon the size of the area to be covered. The powder is sprinkled lightly over the surface of the wound just before closure and after hemostasis has been effected. When used in clean wounds, the powder is sterilized by autoclaving for 30 minutes at 15 pounds pressure and is then pulverized if lumpy, or sterile powder from ampuls is used.[1]

In the closure of the wound, an effort has been made to eliminate dead spaces and to avoid excessive constriction of tissues. In other words, the fact that we have used sulfanilamide in the wound has not been regarded as justification for any letting down in our surgical technique. It is to be emphasized that the method is not infallible and that, even with the use of sulfanilamide, occasional clean wounds will become infected. As a matter of fact, we know of 4 such instances, but as we did not see any of these patients we can make no statement as to why they became infected.

Unfortunately, no statement can be made concerning the occurrence of stitch abscesses in this series. It is possible that some have occurred, but we do not recall any particular instance, nor has any notation of stitch abscesses been found in the histories which were reviewed for this paper. It is our impression that the wounds have healed firmly in approximately the same time, if not somewhat less time than occurred in similar wounds in which sulfanilamide was not implanted, and it has also been our impression that stitch abscesses have been almost, if not altogether absent. At least, we do not recall a wound in this series in which a stitch abscess occurred.

It is to be noted, however, that we have not in the past considered a stitch abscess as being a postoperative wound infection. We have considered the wound infected when the wound was opened and infected material drained from the wound. It is thus evident that we made no distinction between trivial and severe infections. It is our custom to open wounds when there is suspected infection rather than to wait until the infection becomes severe. As a matter of fact, we have, on occasion, opened wounds which were not infected, because we feared infection and would rather let the wounds heal by granulation than run the risk of a severe infection (Case 61, Table I).

The fact that all of these wounds healed by primary intention is evidence that the sulfanilamide does not seriously interfere with the healing of the wound. The question then arises as to whether or not any toxic effects are to be expected from the local implantation of sulfanilamide in the wound.

With the exception of the collection of lymph (which later became infected) in one of the wounds in Case 82, Table I, and the cystitis and a bed sore in Case 61, Table I, the only postoperative complication which occurred in any of these patients was fever. In 4 of the patients operated upon at the Barnes Hospital the temperature exceeded

[1] In some of our cases we used sterile ampuls donated by Eli Lilly and Company.

38.6 degrees C. and in 3 of the Jewish Hospital cases the temperature reached 102 degrees F. The fever was of short duration and there were no local signs of infection. One of the wounds (Case 61, Table I) was opened for a short distance, but no infection was found. It is possible that the sulfanilamide was partly responsible for the fever, but other than causing uneasiness to the surgeon it did no harm. On the other hand, we have seen similar postoperative elevations of temperature in patients who did not have sulfanilamide implanted in their wounds and in whom infection did not develop.

Determinations of the concentration of sulfanilamide in the blood were made on several patients on the first 3 days following operation. The concentration varied from 1 to 9.2 milligrams per cent on the first and second postoperative days and usually only a trace was present on the third day after the operation. The concentration of 9.2 milligrams per cent was present in the blood of a patient who had had 10 grams of sulfanilamide implanted in a large operative wound for exposure of the hip. Lately only 5 grams of the drug have been used for this type of operation, and this usually causes a concentration of from 2 to 4 milligrams per cent in the blood. In patients with small wounds in whom the amount of the drug was small, no determinations were made.

This series does not include patients in whom active tuberculosis was present in the operative field. One such patient developed a sinus about 3 weeks after a sacroiliac arthrodesis. Another developed a sulfanilamide rash on the third postoperative day. This lasted 2 days and then disappeared. The patient was a child 7 years old with a rather large tuberculous focus in the ilium above the acetabulum. This was cleaned out, the cavity was packed with bone chips and sulfanilamide, and the cavity was closed. The temperature rose to 103 degrees F., and the rash appeared on the third day. The child was sent home in a cast on the seventh postoperative day with a normal temperature and no rash.

It is true that sulfathiazol is more effective against staphylococci than is sulfanilamide, and for this reason it may be a more desirable drug to use. It has the possible disadvantage that it is less soluble and tends to remain in the wound longer. We are now running a series of cases with sulfathiazol powder implanted in the wounds, and, when the number of such cases is adequate, we shall report our opinion as to the value of this drug for the prevention of postoperative infection. At present we can only say that we have had no postoperative infections in the 87 clean wounds in which sulfathiazol powder has been implanted, and in small amounts it does not appear to interfere with the healing of the wound.

## CONCLUSIONS

1. Powdered sulfanilamide can be implanted in clean operative wounds and does not interfere with the healing of the wounds unless an unnecessarily large amount of the drug is used.

2. When used in the manner described, there is practically no danger of toxic symptoms.

3. In our hands the drug has reduced the incidence of postoperative infections; no postoperative infection occurred in over 150 consecutive wounds in which the drug was used. In several patients there were two or more wounds.

4. The drug should be sterilized by autoclaving at 15 pounds pressure for 30 minutes or by some other adequate method before it is used in clean wounds. (Sterile ampuls of the powder are on the market).

5. The drug is not a panacea and its local implantation does not warrant any relaxation in the standards of good operating room technique.

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# THE EFFECT OF HARD ROENTGEN-RAYS ON INTESTINES OF NORMAL DOGS FED ON INORGANIC IRON COMPOUNDS

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THE purpose of this experiment is to determine whether or not the inorganic iron compounds can be safely administered orally in their full therapeutic doses to patients whose abdomen or pelvis has to be irradiated by hard roentgen-rays for prolonged periods of time.

Ever since the introduction of roentgen-ray therapy, evidences have been accumulating to signify the importance of secondary radiations (8, 11, 19, 20). In treating a case of deep-seated tumors, such as carcinoma of the cervix uteri, a considerable portion of the curative effect comes from the scattered rays generated in and around the tumorous site, but this very scattering is also largely responsible for irritation of the neighboring vital structures. Whether or not a course of therapy can be successfully carried out, much has to depend upon the fine adjustment between the curative and irritative effects, and the avoidance of any permanent injury to the intestinal mucosa.

It is our experience that the majority of cases of carcinoma of the cervix uteri, coming to the gynecological clinic suffer from moderately severe or severe anemia. So far as we can judge, the anemia in such cases results chiefly from chronic hemorrhages and is mostly of microcytic and hypochromic type. Therapeutically and economically an inorganic iron compound in the form of ferrous sulfate or ferric ammonium citrate would be superior to other types of treatment, such as liver or blood transfusion, and is extremely valuable as an additional therapeutic agent.

Iron, being a heavy metal, is distributed in fine molecules in a solution of ferrous sulfate or ferric ammonium citrate and comes almost continuously in intimate contact with the intestinal mucous membrane when administered in the therapeutic dose. Previous animal experimentations and clinical reports have uniformly shown the mucosa of the small intestine to be the most radiosensitive organ of the abdominal viscera (2, 13, 15, 18). By loading the small intestine with a large quantity of an iron compound during a protracted course of roentgen irradiation of the lower abdomen, it is possible that the additional scattering produced by the iron particles may disturb the balance between the tissue damage and its recuperative ability to such an extent as to cause an irreparable damage of the intestine or prevent a satisfactory completion of the therapy. This question cannot be definitely answered until one has tested it sufficiently in human cases. But prior to any extensive trial clinically, we have applied the test in an animal experimentation.

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## PROCEDURE

Female dogs weighing between 10 and 15 kilograms were used.

In subjecting these dogs to series of roentgen-irradiation our aim was to administer it in such a way that for practical purposes, the dose, individual and total, might be comparable with that in human cases. The therapeutic factors employed in this clinic for the treatment of cases of carcinoma of the cervix uteri, are as follows: 200 kilovolts; 8 milliamperes; 50 centimeters, skin target distance; 0.5 millimeter copper and 2 millimeter aluminum, filter; 1.145 millimeter, half-valve layer in copper; 4 ports in lower abdomen, 2 anterior, 2 posterior, each 16 by 10 centimeters.; daily treatment of 100 to 200 r in air through each of 2 ports; a total dosage to the tumor of 2000 to 3000 r in about 30 days. This is usually the maximal x-ray dose that is safe to give to a patient in addition to the radium therapy. For the dogs in this experiment the same factors were used except that the area of the 4 fields was reduced to 8 by 6 centimeters each. Daily depth doses of 100 r through two ports

were given. The whole course covered a period of 24 days, in which, as will be shown later, no significant pathological change of the small intestine occurred. The depth dose was calculated from an isodose curve with the measurements of the anteroposterior and lateral diameters and the configuration of the circumference of the dog's abdomen. In this way the dose given compared well with the dose in a human case, when consideration is given the difference of sizes. As a matter of fact in human beings the course of x-ray therapy was frequently extended to a month or longer because of certain local or general reactions. Therefore, the dosage given to the dog can be considered to be slightly more intensive.

In an effort to find the x-ray dosage for the dog that will not produce irreparable damage to the intestine, heavier and shorter courses were tried. In one dog, a depth dose of 2400 r was given in 12 consecutive days and at necropsy the small intestine showed many hemorrhagic and ulcerated areas in the mucosa with no important changes in other abdominal viscera. This confirmed the well established observations of Warren and Whipple (14, 18). By giving the 2400 r depth dose in 20 days, we observed only occasional small hemorrhages in the intestinal mucosa, and edema. The overlying epithelium was affected at places, showing necrosis of cytoplasm and clumping of nuclei with sloughing at the surface. Therefore we took the 24 days as the minimal period during which a depth dose of 2400 r can be safely administered.

All dogs were kept in a kennel, fed on a balanced diet, and observed for a week or more in order to make sure that they were normal. The body weight and the blood hemoglobin were determined before and after the experiment.

*Controls.* Two dogs were irradiated daily with roentgen-rays through two ports in the lower abdomen. The anterior ports alternated with the posterior ports. In 24 days a depth dose of 2400 r was given. During the course of roentgen-irradiation, the animals were observed daily as to the body weight, vigor, appetite, and stool. Twenty-four hours after the last dose, the animal was killed and the abdominal viscera were examined. The entire small intestine was examined for change in the serosa as well as in the mucosa. Photographs were taken of the mucosal surfaces. Representative sections were made from the duodenum, jejunum, and ileum. They were fixed in Zenker's solution and studied microscopically.

One dog was given a daily therapeutic dose of 30 cubic centimeters of a 2.5 per cent solution of ferrous sulfate for 24 days and then sacrificed to determine whether there was any change of the intestinal mucosa due to the drug alone. Another dog was treated similarly with 30 cubic centimeters of a 20 per cent solution of ferric ammonium citrate. In the following experiments in which the iron preparations were given in conjunction with roentgen-irradiation, the same dosage was employed. In the light of the experimental data and clinical results in the study of iron metabolism (6, 7), 0.75 gram of ferrous sulfate or 6 grams of ferric ammonium citrate administered daily is considered to be therapeutically adequate for the treatment of iron-deficiency anemia in man.

*Experiments.* Two dogs were given doses of the solution of ferrous sulfate and roentgen-irradiation daily as described. At the end of the irradiation course the dogs were killed and the abdominal viscera, especially the small intestine, were examined macroscopically and microscopically.

Two other dogs were irradiated and given the solution of ferrous sulfate as above, but were sacrificed for pathological examination 8 weeks after the completion of the treatment. This was to allow for the appearance of late effects or to see possible signs of recovery of any intestinal lesion that might be produced by the treatment.

Another series of 4 dogs was likewise irradiated but fed on a solution of ferric ammonium citrate.

In all these experiments, a stomach tube was used for feeding and the dose of the iron compound was completely ingested. During the roentgen-irradiation a plaster cast was put on the animal with windows corresponding to the irradiated fields over the lower abdomen. This made the management of the animal more convenient and irradiation more accurate.

TABLE I.—ANALYSIS OF EXPERIMENTS

| Dog No. | Weight before treatment in kgm. | Weight after treatment in kgm. | Hgb. before treatment in grams per cent | Hgb. after treatment in grams per cent | Antero-posterior diameter of abdomen in cm. | Lateral diameter of abdomen in cm. | Daily skin dose in r through 2 ports | Daily depth dose in r | Days of treatment | Total depth dose in r | Ferrous sulfate 0.75 gm. daily | Ferric ammonium citrate—6 gm. daily | Disposal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 13.5 | 14.1 | 13.6 | 9.6 | 15.0 | 9.5 | 218.6 | 100 | 24 | 2400 | | | Killed at the end of treatment |
| 2 | 13.5 | 13.2 | 12.2 | 9.4 | 15.0 | 8.5 | 215.0 | 100 | 24 | 2400 | | | Killed at the end of treatment |
| 3 | 9.8 | 10.3 | 11.5 | 11.0 | | | | | 24 | | yes | | Killed at the end of treatment |
| 4 | 9.0 | 9.6 | 11.6 | 13.3 | | | | | 24 | | | yes | Killed at the end of treatment |
| 5 | 10.6 | 9.5 | 13.4 | 10.7 | 9.5 | 7.5 | 162.0 | 100 | 24 | 2400 | yes | | Killed at the end of treatment |
| 6 | 10.2 | 11.8 | 12.3 | 12.2 | 12.0 | 8.5 | 178.0 | 100 | 24 | 2400 | yes | | Killed at the end of treatment |
| 7 | 12.7 | 12.0 | 13.0 | 11.8 | 12.8 | 10.0 | 206.0 | 100 | 24 | 2400 | yes | | Killed 8 weeks after treatment |
| 8 | 9.5 | 10.5 | 14.5 | 15.2 | 11.5 | 10.5 | 189.6 | 100 | 24 | 2400 | yes | | Killed 8 weeks after treatment |
| 9 | 10.6 | 10.1 | 13.4 | 11.0 | 12.0 | 8.0 | 177.0 | 100 | 24 | 2400 | | yes | Killed at the end of treatment |
| 10 | 11.8 | 10.4 | 13.8 | 14.6 | 11.0 | 8.0 | 174.6 | 100 | 24 | 2400 | | yes | Killed at the end of treatment |
| 11 | 11.5 | 11.5 | 12.5 | 10.8 | 10.5 | 8.5 | 178.6 | 100 | 24 | 2400 | | yes | Killed 8 weeks after treatment |
| 12 | 10.1 | 9.8 | 11.3 | 8.6 | 12.5 | 7.0 | 187.8 | 100 | 24 | 2400 | | yes | Killed 8 weeks after treatment |

Roentgen ray factors: 200 kilovolts 50 centimeters, skin target distance 4 ports, 2 anterior and 2 posterior.
Size of each port, 6 by 8 centimeters 8 milliamperes. Filter, ½ millimeter copper + 2 millimeters aluminum + 56 millimeters oil.
Half valve layer in copper, 1.145 millimeters.

The data on the control and experimental dogs are given in Table I.

## EXPERIMENTAL OBSERVATIONS

*Controls.* Dogs 1 and 2 were given roentgen rays alone with a daily depth dose of 100 r and a total depth dose of 2400 r, in 24 days. During the course of irradiation their general condition was good with normal appetite and stools. At the end of the treatment, dog 1 gained 0.6 kilogram of body weight, while dog 2 lost 0.3 kilogram. Both of them developed a moderate degree of anemia. The hemoglobin of dog 1 dropped from 13.6 grams per cent to 9.6 grams per cent; that of dog 2, from 12.2 grams per cent to 9.4 grams per cent. At autopsy, the abdominal viscera appeared normal. The mucosa of the small intestine showed occasional areas of slight edema. There were no hemorrhage and no ulceration, however. The above data point to the fact that this amount of 2400 r depth dose given in 24 days was well tolerated by normal dogs without significant clinical and pathological changes in the intestinal tract (Fig. 1).

Dog 3 was given 0.75 grams of ferrous sulfate daily for 24 days and dog 4, 6 grams of ferric ammonium citrate similarly. No roentgen-irradiation was applied. The weight of dog 3 increased from 9.8 kilograms at the beginning to 10.3 kilograms at the end of the treatment; that of dog 4 from 9.0 kilograms to 9.6 kilograms. The hemoglobin of dog 3 at the beginning of the treatment was 11.5 grams per cent and at the end, 11.0 grams per cent while that of dog 4 was 11.6 grams per cent and 13.3 grams per cent, respectively. Postmortem examination of the abdominal viscera, especially the small intestine, showed no important changes. Thus it was clear that neither the ferrous sulfate solution nor ferric ammonium citrate alone was irritative to the intestinal mucosa. Instead, both of them improved the general condition of the dog.

*Dogs irradiated and treated with ferrous sulfate.* Dogs 5, 6, 7, and 8 were given 0.75

gram of ferrous sulfate daily for 24 days and at the same time irradiated as dogs 1 and 2. During the course of treatment, all of them showed no abnormal symptoms. The body weight and hemoglobin as shown in Figures 6 and 7, respectively, indicated no appreciable change. In other words, these animals stood the treatment well, and, when we compared the hemoglobin content of these dogs with that of the control dogs 1 and 2, it appeared that the addition of ferrous sulfate prevented or decreased the anemia produced by a prolonged course of roentgen-irradiation. The mucosa of the small intestine of dogs 5 and 6 sacrificed at the end of the treatment presented a moderate edema and some congestion. There were no hemorrhage and no ulceration (Fig. 2). Microscopically the findings were normal.

To determine if these slight anatomical lesions of the intestinal mucosa will disappear in the course of time, dogs 7 and 8 were kept and fed on normal diets for 8 more weeks. During this period they exhibited all signs of good health. When killed the intestinal mucosa appeared normal macroscopically and microscopically (Fig. 4). Evidently the slight and subclinical irritation of the intestinal mucosa produced by the feeding of ferrous sulfate and abdominal irradiation, completely recovered in the course of eight weeks.

*Dogs irradiated and treated with ferric ammonium citrate.* Dogs 9, 10, 11, and 12 were irradiated as described. In addition they were given 6 grams of ferric ammonium citrate daily throughout the entire course. They stood the treatment well without appreciable change of body weight. As shown in Figure 7 dog 10 gained some hemoglobin at the end of the treatment while the 3 others lost some. In general the hemoglobin content of the blood showed some improvement in comparison with those control-dogs, 1 and 2, but did not behave so well as those receiving ferrous sulfate during the period of irradiation treatment. This might possibly be caused by more irritation to the intestinal mucosa produced by the ferric compound itself and therefore less absorption of the substance. But it was difficult to rule out other factors such as irregularity of food intake, change of weather etc., which might have a similar influence. However, in these dogs no significant clinical symptoms were observed.

Pathological examination of the abdominal viscera of dogs 9 and 10 which were killed immediately after the course of irradiation showed marked edema and hemorrhages of the mucosa of the small intestine, especially in the duodenum and jejunum (Fig. 3). Microscopically, changes were evident in the epithelial cells at the tips of the villi, showing necrosis of the cytoplasm, clumping of nuclei, and superficial ulceration. In the stroma, edema and numerous areas of hemorrhage were seen. In dogs 11 and 12 which were not sacrificed until 8 weeks later, the same findings were observed in the intestinal mucosa (Fig. 5). Although one cannot say definitely from the present data how permanent the lesions may be and how much harm the animal may be done, they were of considerable significance.

### ANALYSIS OF EXPERIMENTS

When Warren and Whipple performed their extensive work on intestinal reactions to roentgen-irradiation, the dogs were irradiated by single massive doses. In this experiment, in an attempt to arrive at a roentgen-ray dose not lethal to the dog and yet at the same time sufficiently intensive and protracted as to be comparable with the therapy of a human case of malignant pelvic tumor, we administered the 2400 r depth dose to groups of dogs in 10, 12, and 20 days. All of them exhibited unmistakable clinical signs of intoxication and pathological evidence of necrosis of cytoplasm of the epithelium, destruction of the nuclei, hemorrhages and ulceration of various degrees of the intestinal mucosa. But when the 2400 r depth dose was given in 24 days the animals stood it without clinical or pathological manifestation. This 2400 r depth dose given in 24 days may be considered to be the limit of tolerance of the small intestine of the dog to roentgen irradiation alone, and any additional effect from the use of ferrous sulfate or ferric ammonium citrate should be taken to be due to the iron compound.

In the dogs irradiated as controls there developed a moderate anemia. In the 10 other dogs receiving daily doses of iron compounds

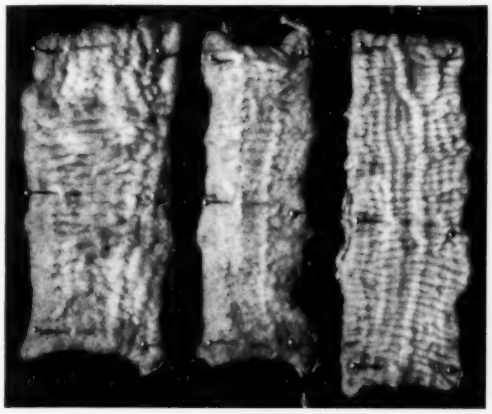

Fig. 1

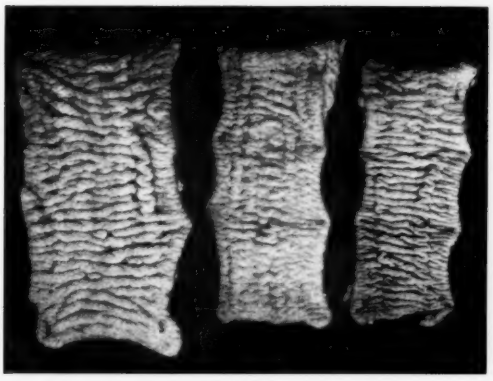

Fig. 4

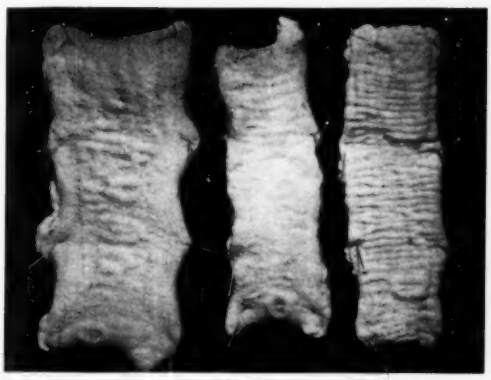

Fig. 2

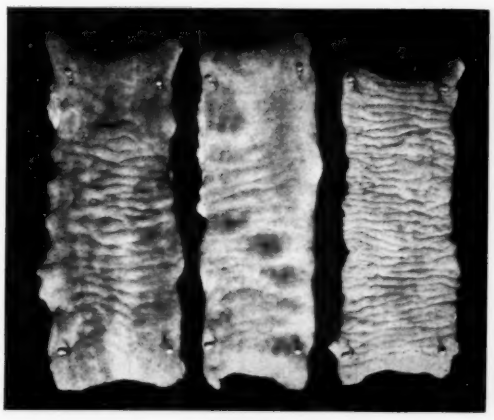

Fig. 5

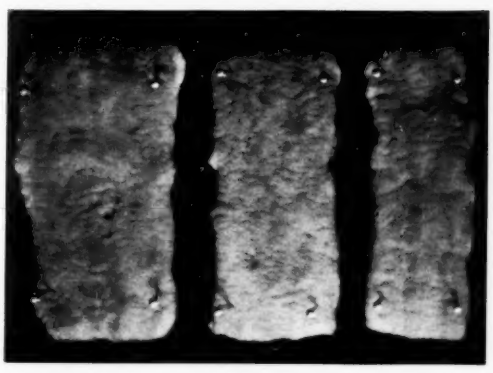

Fig. 3

Fig. 1. Left, duodenum; center, jejunum; right, ileum. Intestine of dog which had received 2400 r (depth dose) in 24 days, showing no significant pathological changes.

Fig. 2. Left, duodenum; center, jejunum; right, ileum. Intestine of dog which had received 2400 r (depth dose) in 24 days as well as 0.75 gram ferrous sulfate daily, showing moderate edema and congestion.

Fig. 3. Left, duodenum; center, jejunum; right, ileum. Intestine of dog which had received 2400 r (depth dose) in 24 days as well as 6 grams ferric ammonium citrate daily, showing marked edema and areas of hemorrhage.

Fig. 4. Left, duodenum; center, jejunum; right, ileum. Intestine of dog which had received 2400 r (depth dose) in 24 days as well as 0.75 gram ferrous sulfate daily, showing normal appearance of mucosa 8 weeks after the last irradiation and medication.

Fig. 5. Left, duodenum; center, jejunum; right, ileum. Intestine of dog which had received 2400 r (depth dose) in 24 days as well as 6 grams ferric ammonium citrate daily, showing marked edema and hemorrhages 8 weeks after the last irradiation and medication.

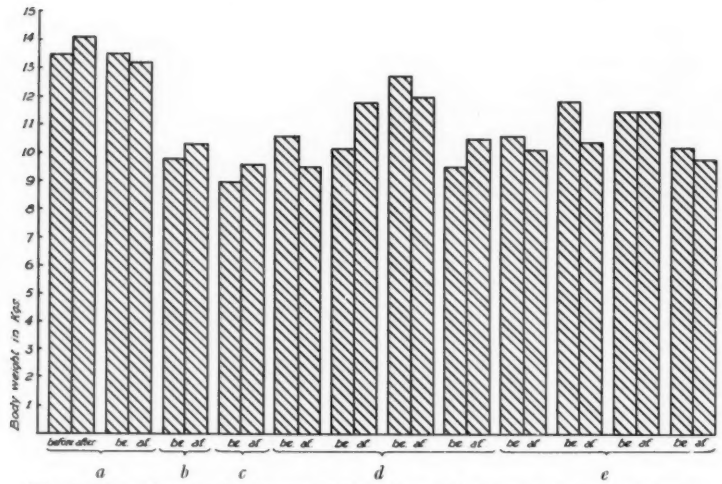


Fig. 6. Chart showing the changes of the body weight of dogs after roentgen irradiation and medication with iron compounds. *a*, Roentgen-rays, 2400 r depth dose in 24 days; *b*, Ferrous sulfate, 0.75 gram Q.D. for 24 days; *c*, Ferric ammonium citrate, 6 grams Q.D. for 24 days; *d*, Roentgen-rays, 2400 r depth dose in 24 days plus ferrous sulfate, 0.75 gram Q.D. for 24 days; *e*, Roentgen-rays, 2400 r depth dose in 24 days plus ferric ammonium citrate, 6 grams Q.D. for 24 days.

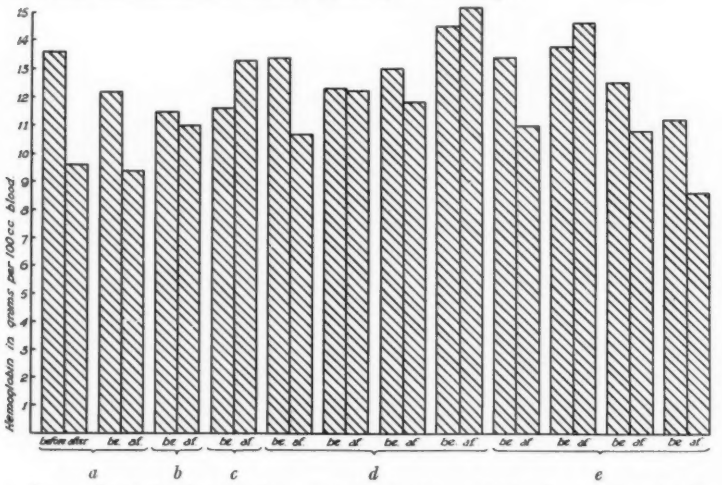


Fig. 7. Chart showing the changes of the blood hemoglobin after roentgen irradiation and medication with iron compounds. *a*, Roentgen-rays, 2400 r depth dose in 24 days; *b*, Ferrous sulfate, 0.75 gram Q.D. for 24 days; *c*, Ferric ammonium citrate, 6 grams Q.D. for 24 days; *d*, Roentgen-rays, 2400 r depth dose in 24 days plus ferrous sulfate, 0.75 gram Q.D. for 24 days; *e*, Roentgen-rays, 2400 r depth dose in 24 days plus ferric ammonium citrate, 6 grams Q.D. for 24 days.

the hemoglobin changes (Fig. 7) before and after irradiation were nil or less marked.

It has been established that metallic substance lying in the path of a roentgen-ray beam will produce secondary radiation. If the intestinal mucosa were smeared with ferrous sulfate or ferric ammonium citrate, one would expect an increase of the effect of the second-

ary rays on the tissues. This may injure the intestinal mucosa and disturb the absorption of the intestinal contents, including the iron compounds. Our experiments have been designed to find out if this additional secondary or scattered radiation from the iron substances not only in a single administration but in repeated daily doses for a prolonged period of time (3 to 4 weeks) would produce clinical symptoms and permanent pathological lesions. The fact that in 10 consecutive dogs the use of ferrous sulfate or ferric ammonium citrate had improved the anemia in at least 7 of them, spoke very strongly that absorption of iron was not significantly disturbed. Figure 7 also suggests that the regeneration of hemoglobin in those dogs treated daily with ferric ammonium citrate was not nearly so good as those treated with ferrous sulfate.

Throughout the whole experiment, we used normal dogs with normal blood hemoglobin. Were we to use subjects in which the blood hemoglobin was below normal as a result of chronic blood loss, perhaps the response to the iron therapy would be more apparent.

Pathological examinations of the viscera of those dogs irradiated and treated with ferrous sulfate showed some edema and congestion of the mucosa of the small intestine. They recovered completely in a period of 8 weeks following the abdominal irradiation. In those dogs irradiated and treated with ferric ammonium citrate one could find numerous large and small hemorrhagic patches and some superficial sloughing of the mucosa of the small intestine, more marked in the duodenum and jejunum. These lesions persisted even 8 weeks after the therapy. How long these hemorrhages in the small intestine will remain and what permanent injury may result, are questions that cannot be answered by the present experiment which had not been carried on long enough to decide. So far it was reasonable to believe that the lesions produced in the intestines of dogs fed with ferric ammonium citrate in conjunction with roentgen irradiation was not without clinical importance. As it was necessary to employ larger amounts of ferric ammonium citrate than ferrous sulfate for the same therapeutic result in the treatment of anemia due to iron deficiency (6 and 7), and the amount of secondary roentgen-rays produced is directly proportional to the mass present, no doubt the greater quantity of iron of the ferric compound was responsible for the added injury in the small intestine.

The practical application of our findings opens up a field of considerable clinical significance. The number of cases of gynecological malignant tumors associated with anemia that require roentgen-irradiation is large, and the difficulties of getting large amounts of blood for transfusion and the slow response to diet therapy alone are often disheartening in their clinical management. Although inorganic iron compounds might have been used irregularly and in short periods of time in conjunction with roentgen irradiation, no systematic and prolonged treatment has been mentioned in the literature. In our clinic we refrained from its use for a number of years for fear of an increase of undesirable radiation effect or reduction of the threshold of tolerance to radiation.

The present experiment has demonstrated that it is quite safe and definitely useful to administer ferrous sulfate to dogs during abdominal irradiation. Ferric ammonium citrate may be useful also in elevating the blood hemoglobin, but the presence of large hemorrhagic and some superficial ulcerative lesions of the small intestine with it, even after a rest of 8 weeks, suggests that it is harmful to the individual and is not desirable, until it can be proved that the intestinal lesions are not permanent and of no clinical significance.

## SUMMARY AND CONCLUSION

1. Normal dogs irradiated through the abdomen by a protracted course of roentgen-rays for a total depth dose of 2400 r showed no clinical symptoms during the course of treatment and no pathological change of the small intestine at the end of the irradiation.

2. The daily administration of ferrous sulfate or ferric ammonium citrate in the therapeutic dose throughout the period of irradiation, tended to increase the blood hemoglobin.

3. Clinically there was no significant sign of intoxication in dogs irradiated and treated with either the ferrous or ferric compound.

4. Pathological examination of the small intestine showed a mild degree of edema and

congestion of the mucosa in those animals irradiated and treated with ferrous sulfate. These changes disappeared completely in a period of 8 weeks.

5. In those irradiated and treated with ferric ammonium citrate there was more edema and large hemorrhagic areas in the mucosa of the small intestine. These diffuse, severe hemorrhagic lesions persisted for at least 8 weeks after completion of the roentgen-irradiation.

6. The data presented serve to indicate that ferrous sulfate is definitely valuable in the treatment of the anemia as a result of chronic blood loss and it is harmless to the small intestine while the animal is undergoing abdominal roentgen-irradiation. Ferric ammonium citrate when given in its therapeutic dose is irritative to the intestinal mucosa under similar circumstances and its use is not recommended.

The authors are indebted to Dr. F. E. Whitacre and Dr. C. K. Hsieh for their suggestions and help in carrying out the experiment.

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# COMBINING SPLENECTOMY WITH TOTAL GASTRECTOMY

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TOTAL gastrectomy has now become an accepted surgical procedure. But a short time ago it was an operation which had been successfully accomplished only by a limited number of surgeons. The technical measures for its successful performance, however, have now been worked out and established. Total gastrectomy is being performed successfully today by many surgeons over the country. Patients upon whom total gastrectomy has been done have now lived long enough to establish the fact securely that without a stomach and with a loop of jejunum attached to the esophagus serving as a substitute for one, patients can maintain their weight and strength, and, with the aid of proper minerals and acids, their normal blood picture also.

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When a relatively new and major surgical procedure such as total gastrectomy first appears in the surgical world, attention is largely focused upon the development of its technical steps and

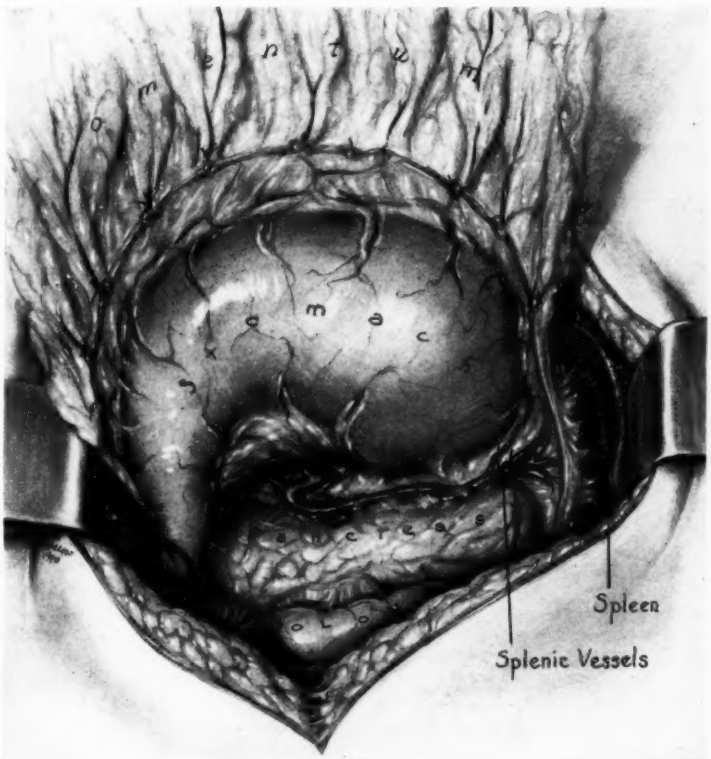


Fig. 1. In this illustration the great omentum is separated from the transverse colon and turned upward, thus exposing the lesser peritoneal cavity, the posterior wall of the stomach, the root of the gastric vessels and the splenic vessels, pancreas, and spleen. The drawing demonstrates the posterior exposure, together with the point of ligature of the splenic vessels when splenectomy is combined with total gastrectomy.

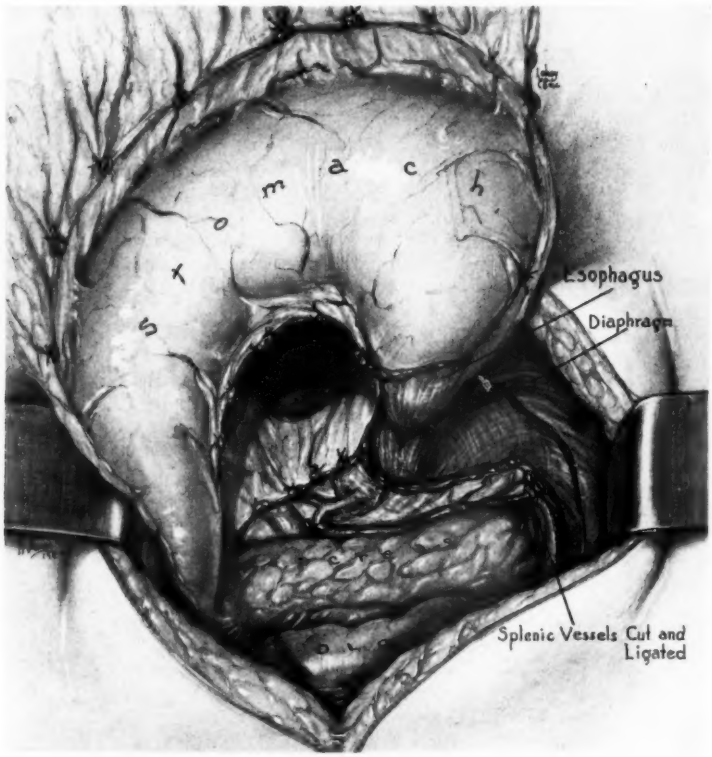


Fig. 2. In this illustration the spleen has been removed and the ample exposure of the esophagus following splenectomy is demonstrated. One can likewise see the peritoneum of the diaphragm as it extends over the esophagus, from which will be cut the apron of peritoneum with which to suspend the jejunum anastomosed to the esophagus.

associated aids, such as anesthesia, to make its mortality rate such that it can be considered as an operation which is justifiable to use in patients.

With the exception of the suggestion in this communication of the occasional employment of the additional step of splenectomy, the method of performing total gastrectomy has now been quite well established so that its mortality rate, certainly for the character of the operation, is within reasonable limits. We have now done 33 total gastrectomies with 9 fatalities. This figure includes every total gastrectomy we have ever undertaken and represents not only the mortality rate after we acquired experience with the procedure but that of the pioneer period when we were developing methods whereby the causes of some of our early failures (leakage) and fatalities could be overcome.

In the course of this experience we have five times removed the spleen together with the entire stomach, and while we do not wish to advocate splenectomy in all patients upon whom total gastrectomy is undertaken, the addition of this step will, in those cases in which the malignancy has involved the greater curvature segment opposite the hilum of the spleen, not only make the operation easier but also, by the removal of the spleen with this area, make it possible to do more complete and radical removal of the involved stomach. The addition of this step to total gastrectomy does not appear to add greatly to the hazard of the operation since in not 1 of the 5 cases in which this has been done has there been a death.

Since total gastrectomy is an operation which will be reserved almost entirely for those patients either with a linitis plastica type of carcinoma of the stomach in which gross glandular metastases

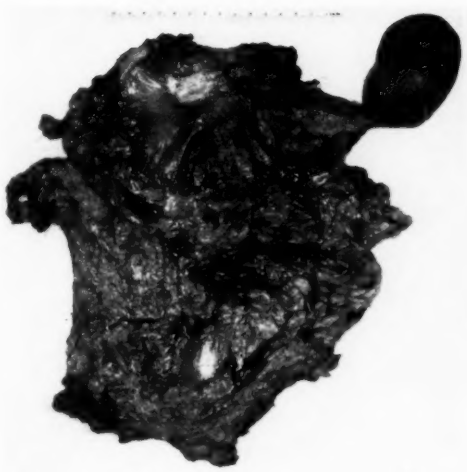

Fig. 3. Totally removed stomach together with all of the omentum and the attached spleen. The carcinoma of the stomach was of the linitis plastica type.

Fig. 4. Another specimen showing the total removed stomach with omentum, together with the attached spleen. Carcinoma of stomach was of linitis plastica type.

are so often lacking or with complete involvement of the stomach by leiomyosarcoma which is of such low grade of malignancy, it is quite desirable, we believe, to remove the entire omentum with the stomach as has been advocated by so many European surgeons writing on subtotal gastrectomy for malignancy. Removal of the entire omentum by separating it from its high attachment to the transverse colon makes it possible to remove with the stomach numerous lymph nodes in the gastrocolic omentum into which extensive carcinoma of the stomach so frequently metastasizes. Not only does the removal of the entire omentum make it possible to do a more extensive removal of gland-bearing areas with total gastrectomy but the addition of this technical step decidedly simplifies the removal of the stomach itself. As the omentum is detached from the colon and turned upward and the lesser peritoneal cavity is opened so that when the omental attachment to the colon is completely freed, the blood supply of the stomach and spleen becomes clearly visualized (Fig. 1). With this exposure of the stomach turned upward, the gastric artery with its branches comes plainly into view and the splenic vessels as they pass to the hilum of the spleen appear directly under the eye. If because of extension of the disease, because of troublesome bleeding from the vasa brevia vessels running between the greater curvature of the stomach and the spleen, it seems that a better exposure of the lower end of the esophagus can be obtained, the splenic vessels may be ligated as trunks at this point. All of these three points have at times in our cases influenced us toward adding the operation of splenectomy to that of total gastrectomy. Four of the operations of total gastrectomy combined with splenectomy have been performed by me and one by Dr. Marshall, and we both have been impressed with the fact that with the addition of this procedure the operation has been made decidedly easier.

With the omentum completely freed from the colon and with the splenic vessels safely ligated, the parietal peritoneum outside the spleen is incised and the spleen is mobilized inward. Its pedicle can now be clamped distal to the ligature of the splenic vessels and the vascular splenic pedicle cut. This leaves the spleen attached to the upturned stomach by the vasa brevia vessels, and the large vacant area previously occupied by the spleen provides a surprisingly advantageous exposure of the left half of the diaphragm with the left lobe of the liver attached to it. With severing of the avascular attachment of this left lobe of the liver from the diaphragm, the lower end of the esophagus as it passes through the diaphragm and joins the stomach can be brought under direct vision from all sides (Fig. 2). With this wide exposure in a cavity of such amplitude, the technical manipulation of cutting anterior and posterior apron flaps of peritoneum for suspension of the

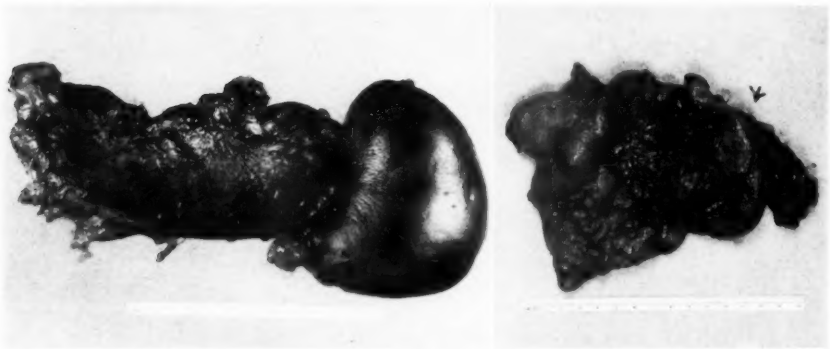

Fig. 5, left. Total gastrectomy for carcinoma of the linitis plastica type, together with a very large spleen with attached vasa brevia. This spleen was of such size as to interfere with total removal of the stomach. This is one of the early cases in which the omentum was not removed.

Fig. 6. Total gastrectomy for carcinoma of the linitis plastica type, together with splenectomy, indicated by the arrow.

anastomosed jejunum, as devised and advocated by one of us[1] in a technical article on total gastrectomy, together with the introduction of the anastomosing sutures, is made surprisingly easy.

## CONCLUSIONS

The occasional advantage of combining splenectomy with total gastrectomy is advocated when in this operation oozing, particularly from the splenic veins in the hilum of the spleen, occurs during the course of the operation, when with malignancy on the greater curvature it is desirable to undertake a wider removal than could be accomplished with the spleen remaining, and particularly when an enlarged spleen so hampers exposure at the gastro-esophageal junction that safe anastomotic sutures cannot be inserted under good direct vision.

Its addition as a technical step in total gastrectomy so adds to the ease with which the operation may be performed that it lessens rather than adds to the risk of the operation.

[1]Lahey, F. H. Complete removal of the stomach for malignancy, with a report of five surgically successful cases. Surg., Gynec. & Obst., 1928, 67: 212–223.

# MUCOCELE OF THE APPENDIX AND PSEUDOMYXOMA PERITONEI

## A Clinical Review and Experimental Study, with Case Report

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THE term "mucocele of the appendix" was first introduced by Feré (1876) to apply to the enlargements of the appendix containing mucous or pseudomucous material. According to Masson and Hamrick (1930), Virchow was the first to describe this condition in 1863, but Weaver (1937) credits Rokitansky with having described the pathology in 1842. Secondary peritoneal deposits resulting from rupture of mucocele of the appendix were first designated as "pseudomyxoma peritonei" by Fraenkel (1901), although Werth (1884) had previously used the same term to apply to the secondary peritoneal deposits or growths resulting from rupture of certain ovarian cysts. Our interest in this subject was stimulated by a clinical case, a report of which is given below. It is our purpose, following this case report, to review our clinical knowledge of mucocele of the appendix and pseudomyxoma peritonei, and to report the results of animal experimentation carried out in an attempt to reproduce these conditions.

### CASE REPORTS

Mr. D. P., aged 44 years, was first seen by one of us (M.G.) on November 6, 1939, with a chief complaint of general abdominal pain of one day's duration. There was some nausea but no vomiting. The bowels had not moved since the onset of illness. The temperature was normal and the pulse 80. Examination of the abdomen revealed moderate tenderness in the lower right quadrant, over McBurney's point and closer to the midline. There was marked muscle guard making it difficult to palpate any masses. The patient stated that he had had a similar attack about 1 year previously from which he had recovered under conservative management.

Laboratory findings were as follows: red blood cells, 5,300,000; hemoglobin 102 per cent; white blood cells, 12,400; segmented cells, 62 per cent; staff cells, 8 per cent; lymphocytes, 19 per cent; eosinophils, 3 per cent; mononuclears, 8 per cent. Urinalysis showed specific gravity, 1028; albumen, negative; sugar, negative. Microscopic examination showed 1 or 2 red blood cells and 30 to 35 white blood cells per high-power field.

A diagnosis of acute or subacute recurrent appendicitis was made and operation was advised. This was refused at first but consented to the following day.

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Operation was performed November 7, 1939, by Dr. Grodinsky. Under gas-ether anesthesia, the abdomen was opened through a McBurney incision. There was considerable clear free fluid in the peritoneal cavity. A large mass was encountered posteromedial to the cecum, and adherent to the cecum and small bowel. After careful separation by sharp and blunt dissection, this mass proved to be a greatly enlarged appendix. The mesoappendix and base of the appendix were ligated with chromic No. 2 catgut and the appendix was removed. The stump was carbolized but not inverted. A limited exploration revealed no further pathology in the abdomen. The abdominal wall was closed in layers without drainage.

Pathological report by Dr. Rubnitz: The appendix was egg-shaped, measuring 8.5 centimeters in length and 5 centimeters in diameter (Fig. 1). The surface was red, injected, and somewhat roughened in the areas where adhesive bands had been separated during removal. The lumen was filled with thick, jelly-like material typical of mucus. This material gave a reduction test for mucin and stained red with mucicarmine. The wall was made up of fibromuscular tissue infiltrated with leucocytes (mostly lymphocytes). The mucosa was totally atrophied, no epithelial cells being demonstrable (Figs. 2 and 3). Pathological diagnosis: mucocele of the appendix.

The patient made an uneventful recovery and, when last seen, October, 1940, was in good health.

### CLINICAL REVIEW

Very little appeared in the literature on this subject until 1909, when cases were reported by Neumann in Europe and Kelly in this country. Interest again lagged until 1915, when Phemister described the clinical and pathological picture in detail, and attempted to reproduce the condition in dogs. Between 1915 and 1930, there appeared scattered reports by Castle (1915), Nash (1919), Davison (1922), Milliken and Poindexter (1925), and Topping (1928). In 1930, Masson and Hamrick reviewed the literature and described 6 cases. Following this, numerous articles appeared both in this country and abroad. Among them were the papers of Vorhaus (1930), Birkenfeld (1931), Squires (1931), Kemkes (1932), Mayo and Fauster (1932), Hentz (1932), Lifvendahl and Ries (1932), Bell (1935), Abdanski (1936), Wilmoth (1936), Jones and Carmody (1936), Jackson (1936), Olson (1936), Sarff (1936), Dannreuther (1936), Weaver (1937), Morgan (1937), Waugh and Findley (1937), Bittmann (1939), Dordick

(1939), Latimer (1940), and Woodruff and McDonald (1940).

*Incidence.* Kelly (1909), quoting Stengel, gave an incidence of 0.3 per cent for mucoceles, in 9,108 autopsies. This agrees quite closely with Castle's (1915) figure of 0.2 per cent. Mayo and Fauster (1932) reported 76 mucoceles in 31,200 appendectomies, an incidence of 0.24 per cent. On the other hand, Dannreuther (1936) reported an incidence of only 0.1 per cent in 8,457 appendectomies, and Weaver (1937) of 0.11 per cent in 6,225 appendectomies. According to Jones and Carmody (1936), the total number of cases of mucocele of the appendix reported up to that time was approximately 400. D'Aunoy and Fine (1934) estimated the total number of reported cases of pseudomyxoma peritonei of appendiceal origin to be 90. Phemister (1915) stated that mucocele is associated with normal involution of the appendix in patients between the ages of 35 and 50. The average age was found by Masson and Hamrick (1930) to be 57 years (6 cases) and by Mayo and Fauster (1932) 42½ years (70 cases). Dannreuther (1936) reported mucocele most common in patients past middle age. Most authors have found a slightly greater incidence in females than in males.

*Etiology.* As has been stated, Phemister (1915) thought the condition was due to normal involution of the appendix and the commonly associated inflammation. Milliken and Poindexter (1925) described three steps in the formation of mucocele: (1) secretion of mucin into the crypts; (2) failure of reabsorption; (3) the conversion of mucin into pseudomucin. Vorhaus (1930) described a preliminary step in the formation—stenosis, although he reported a case diagnosed before operation by ingestion of barium and examination by x-ray. A similar case was reported by Lifvendahl and Ries in 1932. This would indicate that complete or permanent obstruction at the base is not necessary and that infection may enter the lumen of the appendix. Perhaps it is the amount and character of the infection which determines whether a relatively sterile mucocele or an infected, gangrenous appendix results from partial or complete obstruction at the base. Wangensteen and his associates (1937, 1939) have repeatedly demonstrated the production of acute appendicitis by obstruction of appendices not previously irrigated. Mayo and Fauster (1932), Jones and Carmody (1936), Dannreuther (1936) and Jackson (1936) described the essential steps in the formation of mucocele and pseudomyxoma peritonei as obstruction, absence of gross infection, secretion faster than absorption, distention, formation of diverticula and rupture with the formation of secondary pseudomyxoma peritonei. Our observations would seem to confirm this view.

*Pathology.* The size of mucoceles of the appendix varies greatly, from that of a normal appendix to that of a man's head. The shape may be globular, egg-shaped, conical, or sausage-like, depending on the location of the obstruction in relation to the base of the appendix (Neumann, 1909; Nash, 1919; Jones and Carmody, 1936; Jackson, 1936; Weaver, 1937).

The nature of the wall is likewise quite variable. In general, however, the earlier stages reveal a hyperplastic, secretory mucosa with cuboidal or columnar goblet cells, considerable round cell infiltration of the submucosa and hypertrophy of the muscularis. With increasing distention of the lumen by accumulated secretion, the mucosa becomes gradually atrophic and, in the larger specimens, epithelial cells are entirely absent. Likewise in the later stages, the rest of the wall becomes thinned out with loss of muscle fibers and replacement by connective tissue. With the thinning of the wall and the increase of internal pressure, diverticula may form on the mesenteric or antimesenteric borders. Finally, rupture of the wall of the diverticula or of the appendix proper may occur, with extrusion of the contents of the lumen into the general peritoneal cavity and formation of secondary growths or deposits, pseudomyxoma peritonei. The secondary growths or deposits are usually incapsulated by walls of fibrous tissue with varying degree of inflammatory, cellular infiltration (Phemister, 1916; Nash, 1919; Milliken and Poindexter, 1925; Mayo and Fauster, 1932; Abdanski, 1936; Jones and Carmody, 1936; Jackson, 1936; Olson, 1936; Sarff, 1936; Dannreuther, 1936; Morgan, 1937).

The contents of mucoceles vary according to the stage, degree of inspissation, and amount of cellular reaction. The earlier formations contain a somewhat thin, clear or slightly turbid, sticky fluid. This becomes thicker and more gelatinous with the reabsorption of water. Where considerable leucocytic reaction has occurred, the contents become whitish, putty-like or cheesy in consistency, resembling caseous or necrotic material. Many authors make a distinction between true mucin and pseudomucin on the basis of staining reaction (mucicarmine) or the reduction tests (Hammarsten, 1904; Lewis, 1914; Phemister, 1915; Nash, 1919; Milliken and Poindexter, 1925; Masson and Hamrick, 1930; Vorhaus, 1930; Birkenfeld, 1931; Hentz, 1932; Wilmoth, 1936 and Morgan, 1937). However, all gradations of staining reactions occur and reduction tests may

be obtained with true mucin. It seems therefore an unnecessary and valueless distinction, and the term pseudomucin had best be abandoned with the realization that a variety of chemical compounds exists in the substance commonly known as mucin.

Some mucoceles contain small, globular, semitransparent bodies the size of a millet or sago seed (1 to 10 mm. in diameter) within the diffuse mucous contents. These are probably localized areas of inspissation occurring in regular formation (Milliken and Poindexter, 1925; Hentz, 1932).

That the contents of a mucocele may be actually bactericidal has been suggested by Lifvendahl and Ries (1932). The fact that our material, obtained from the contents of mucoceles and pseudomyxomata peritonei, could be kept for long periods without preservatives and did not show evidence of decomposition would seem to support this contention. This may help explain the relative sterility of the contents of mucoceles and the failure of appendicitis and gangrene to occur.

The secondary peritoneal deposits or transplants following rupture of mucoceles of the appendix vary in their contents in the same way as the original mucoceles, depending upon the same factors. However, due to the greater inflammatory reaction, leucocytic infiltration is more common in these secondary deposits, the contents of which are therefore usually opaque and white in color.

*Complications.* The commonest complication, or rather sequela, of mucocele of the appendix, according to most authors (Phemister, 1915; Jackson, 1936; Dannreuther, 1936; Morgan, 1937, etc.) is pseudomyxoma peritonei. As stated previously, this name was first applied to the daughter peritoneal lesions resulting from rupture of mucocele of the appendix by Fraenkel (1901), although the term had been previously applied by Werth (1884) to similar peritoneal lesions resulting from rupture of certain ovarian cysts. Thus, this condition may result from either mucocele of the appendix or ovarian cyst in the female, but from mucocele of the appendix alone in the male.

Intestinal obstruction from pressure of the enlarging mucocele of the appendix or from intussusception due to the presence of the mucocele has been reported in several cases (Morgan, 1937). Associated carcinoma of the appendix has likewise been reported. It has been suggested that this malignancy may cause the obstruction of the lumen which allows the accumulation of mucus and the production of mucocele, or that the mucocele

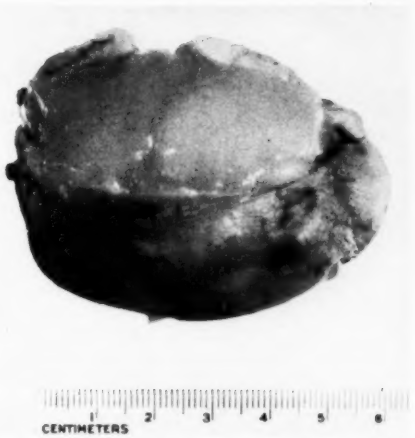


Fig. 1. Photograph of mucocele of the appendix in clinical case (D.P.). Part of wall removed to show mucous contents. Photograph taken after fixation, some shrinking having occurred.

may bring about stimulation of the epithelium and secondary malignant change (Waugh and Findley, 1937). Diverticula of mucoceles of the appendix are common. Dordick (1939) reported a case of mucocele of the appendix with three solid diverticula filled with neuromatous overgrowth and one cystic diverticulum filled with mucus similar to that within the appendix.

*Clinical picture.* The symptoms of mucocele of the appendix are rather vague and indefinite (Phemister, 1915; Vorhaus, 1930; Jones and Carmody, 1936; Jackson, 1936). There is usually pain in the lower right quadrant of the abdomen, but this is not apt to be severe or well localized. The initial epigastric or paraumbilical pain of acute appendicitis is often absent. There may be slight nausea, usually without vomiting. Fever and leucocytosis are also apt to be absent. Constipation may or may not be present. Muscular rigidity is not present unless there is marked associated inflammatory reaction. Sometimes the symptoms are those of intestinal obstruction due to pressure of the mucocele on adjacent loops of bowel or to intussusception. Quite often the mucocele is large enough to be palpated through the abdominal wall and this facilitates the diagnosis. If the obstruction to the lumen of the appendix is incomplete or the lumen has reopened, the appendix may be visualized by the ingestion of barium and by x-ray examination, thus further aiding in the diagnosis (Vorhaus, 1930; Lifvendahl and Ries, 1932). However, the diagnosis is seldom made preoperatively, and operation is

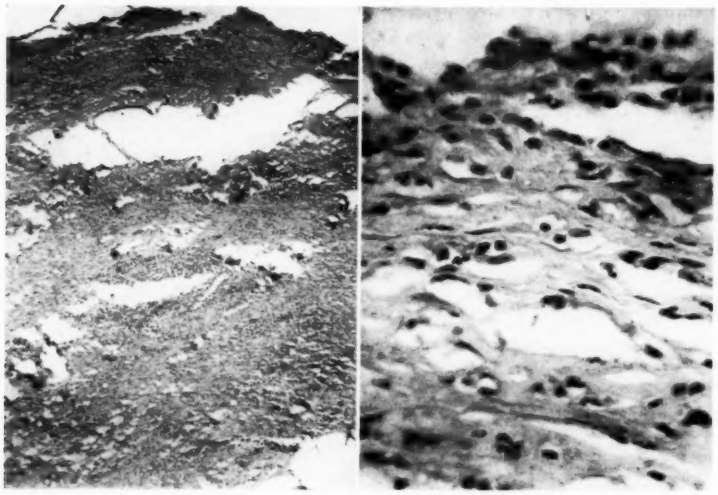

Fig. 2, left. Photomicrograph of section through wall of mucocele of appendix (D.P.), showing atrophy of mucosa and replacement fibrosis. (Hematoxylin and eosin). ×30.

Fig. 3. Photomicrograph of inner part of same section. Note the cellular infiltration, and the absence of epithelial cells in the mucosa. (Hematoxylin and eosin). ×435.

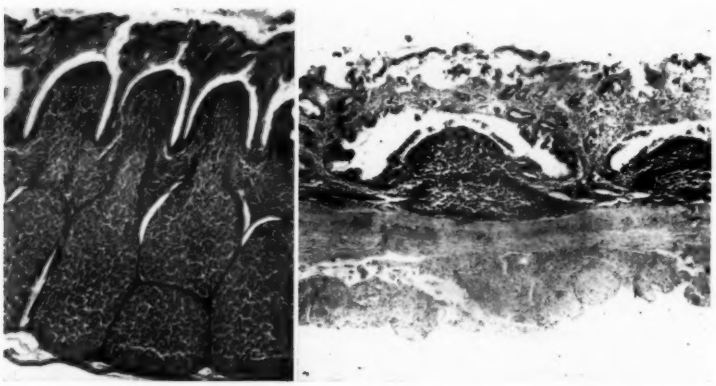

Fig. 4, left. Photomicrograph of section through wall of normal rabbit appendix, showing thin seromuscular layer and very thick submucous or lymphoid layer with cone-shaped lymphoid follicles arranged at right angles to long axis of appendix. (Mallory's C. T. stain). ×30.

Fig. 5. Photomicrograph of section through wall of mucocele of appendix in rabbit 8, showing relative and absolute increase in thickness of seromuscular layer and marked decrease in thickness of lymphoid layer with change in axis of lymphoid follicles. (Hematoxylin and eosin). ×30.

usually performed for appendicitis which most closely resembles this condition.

*Treatment and prognosis.* The treatment of mucocele of the appendix consists essentially of appendectomy. As long as the lesion is confined to the appendix and no leakage has resulted into the general peritoneal cavity, complete recovery is the rule. If leakage has occurred and daughter

lesions are present scattered through the peritoneal cavity, the prognosis is much more serious. Due to their multiplicity and indefinite outlines, it is physically impossible to remove all such secondary deposits or transplants surgically. There is evidence that at times the secondary lesions will disappear following the removal of the primary lesion by appendectomy. However, the secondary lesions often take on malignant characteristics and continue to grow after the removal of the appendix. This has led to the view that two types of secondary pseudomyxomatous growths may result: the one, a benign, passive deposit of the mucous contents from the appendix which may reabsorb after the removal of the primary lesion; the other, a transplant of epithelial cells from the appendix to the general peritoneal surfaces where they take on malignant characteristics. Woodruff and McDonald (1940) believe that malignant, pseudomyxomatous growths, secondary to mucocele of the appendix, occur only as the result of the transplantation of epithelial cells from previously existing malignancy in the appendix. However, the possibility of change in the serosal cells themselves by stimulation from the appendiceal contents must also be kept in mind. X-ray treatment for pseudomyxoma peritonei is recommended by some authors (Masson and Hamrick, 1930), but its value has not been proved and is difficult to evaluate as long as the secondary lesions may disappear spontaneously after removal of the appendix. More often the pseudomyxoma assumes malignant characteristics and results fatally.

Fig. 6. Photograph of mucocele of appendix and secondary implant in rabbit 8. Note that part of the contents of the appendix had been lost before this photograph was taken.

### ANIMAL EXPERIMENTATION

Naeslund (Masson and Hamrick, 1930) produced mucocele of the appendix and pseudomyxoma peritonei in rabbits by ligating the base of the appendix. Similar results were obtained by Antoine (1935). Phemister (1915) attempted to reproduce the condition in 7 dogs by dividing the caecal appendage at the base and closing both ends without disturbing the blood supply. All but 1 dog developed gangrene and peritonitis. In the one exception, the lumen had become reestablished and the cecal appendage returned to normal. Phemister believed that the failure was due to the too sudden obstruction with the shutting off of the intrinsic blood supply by distention.

In a very exhaustive and conclusive series of experiments, Wangensteen and his associates (1937, 1939) studied the problem of production of appendicitis in dogs and other animals by various means of obstruction to the lumen of the appendix. They showed that obstruction plus infection almost invariably produced appendicitis and gangrene, whereas infection alone did not. On the other hand, increase in the intraluminal pressure, even in relatively noninfected (washed) appendices, resulted in shutting off the intrinsic blood supply and in gangrene of the organ. Obstruction in the washed cecal appendages of dogs was found to be usually well tolerated, resulting either in normal appendages or occasionally in mucocele.

Wells (1937) was able to produce mucocele in rabbits by ligature of the base of the appendix without ligature of the vessels. When trauma to the mucosa was added to this procedure, acute appendicitis resulted. Wangensteen was not able to confirm the results of Wells in regard to the effect of trauma to the mucosa. Wells did not state whether the appendices had been irrigated before ligature, a procedure which, we found, has an important influence upon the results.

In casting about for a laboratory animal suitable for experimental production of mucocele, we came to the conclusion that, of the common laboratory animals, the rabbit possesses an appendix most closely resembling that of the human in structure and function. This opinion agrees with that of Wangensteen and his associates (1940) who studied the appendix from a standpoint of comparative anatomy and came to the conclusion that only the rabbit and anthropoid ape possess appendices resembling the human, morphologically and physiologically.

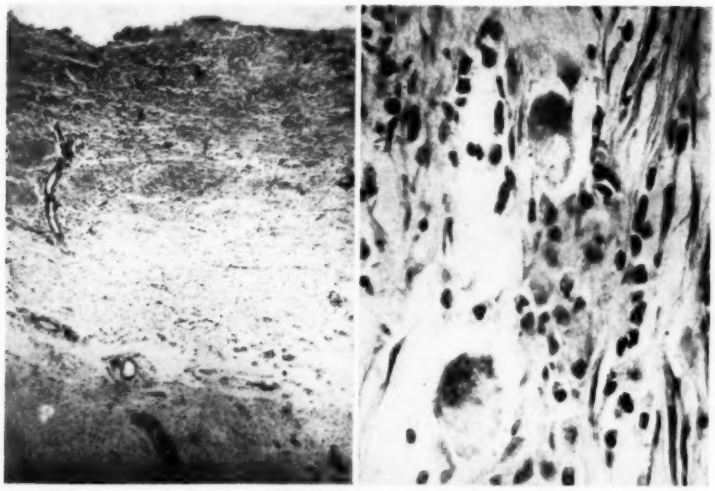

Fig. 7, left. Photomicrograph of section through wall of secondary implant, rabbit 8, showing general arrangement of the entire wall and zone of necrosis near inner surface. (Delafield's hematoxylin and eosin—azure II). ×30.

Fig. 8. Photomicrograph of part of same section under higher magnification, showing giant cells, large mononuclear cells, histiocytes and isolated epithelium like cells. (Delafield's hematoxylin and eosin—azure II). ×435.

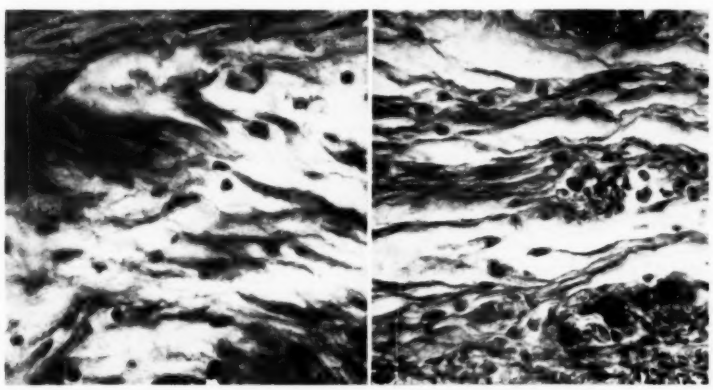

Fig. 9, left. Photomicrograph of part of section through thicker part of wall of secondary implant, rabbit 8, showing young connective tissue of myxomatous character. (Mallory's C. T. stain). ×435.

Fig. 10. Photomicrograph of part of section through wall of neck of secondary implant, rabbit 8, showing more mature connective tissue and increased vascularity. (Mallory's C. T. stain). ×435.

*The normal rabbit appendix.* In the rabbits used in our experiments, weighing between 5 and 6 pounds, this structure is larger than in the human, averaging about 10 centimeters in length and 1 to 1.5 centimeters in diameter. There is a double blood supply, from the appendiceal vessels and from the vessels of the adjacent loop of jejunum, both of which lie in a common mesentery. The wall of the appendix is much thinner than in the human, particularly the seromuscular layer which makes up only about 4 per cent of the wall. The submucosa or middle layer, on the

Fig. 11. Photograph of mucocele of appendix produced by ligation in rabbit 16.

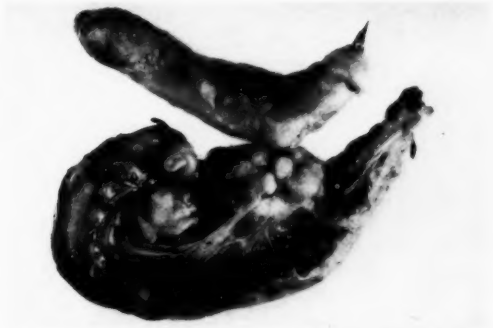

Fig. 12. Photograph of mucocele of appendix and secondary implants in mesentery of small gut, with segment of latter, rabbit 12.

other hand, is much thicker than in the human and forms the bulk of the appendiceal wall, comprising about 72 per cent of the total thickness. This layer consists of elongated, cone-shaped follicles of lymphoid tissue, arranged at right angles to the long axis of the appendix and separated from each other by fibrous trabeculae extending from the seromuscular layer to the mucosa. The inner or mucous layer makes up about 24 per cent of the total wall. The epithelial cells of the mucosa, for the most part, closely resemble the mucin producing cells in the human appendix and are normally filled with their mucinous secretion (Fig. 4). In both the rabbit and human, the appendix is chiefly an organ of secretion rather than of absorption.

*Material and methods.* Twenty-six rabbits were used in the ligation and injection experiments. In the ligation experiments, each animal was operated upon at least twice: the first operation consisting of ligation of the appendix and the second of exploration of the peritoneal cavity from 2 to 8 weeks later. Some animals were operated upon three or four times. Ligation was usually done about 2 centimeters distal to the base of the appendix, to facilitate later removal of the appendix with the original ligature included. The appendiceal vessels were not included in the ligature. Silk or flat umbilical tape was used for ligating, with equal success in most cases. In our experience, the tightness of the closure was a very important part of the procedure. We felt that some of our failures to produce mucocele were due to the incomplete closure of the lumen. In the first two experiments, the appendices were ligated without preliminary irrigation of the lumina. Both animals died of gangrenous appendicitis and peritonitis. In subsequent experiments, we preceded the ligations by irrigation of the lumina with 60 to 80 cubic centimeters of normal salt solution, using a syringe and needle as suggested by the work of Wangensteen and his associates (1937). This procedure insured relatively clean lumina before ligation and resulted in reduction in the mortality rate practically to zero, except when complicating factors were present.

In the injection experiments, the animals were injected intraperitoneally with material taken from the contents of mucoceles or from the contents (and walls) of pseudomyxomatous lesions produced in other rabbits. When the material was too thick to go through a needle, it was first emulsified and diluted with sterile normal salt solution. In a few instances, the material was passed through a Seitz filter, and the filtrate and residue (or original substance) were injected into separate animals. An ordinary Luer syringe and No. 20–22 gauge needle, about 1.5 inches long, were used for the injections.

*Results of ligation.* By the technique described mucoceles, varying in size and stage according to the lapse of time between operations, were produced almost at will (10 out of 12 animals) (Figs. 6, 11 and 12). In addition, when sufficient time was allowed to elapse between ligation and the secondary exploration, rupture of or extension through the walls of mucoceles with the production of secondary deposits or implants, pseudomyxomata peritonei, took place in several animals (6 of 10 animals that developed mucoceles) (Figs. 6 and 12). The following protocol of the experimental work on rabbit 8 is typical and is reproduced as an example of the findings in several (6) of these animals.

*Rabbit 8.* First operation, March 21, 1940. Sodium pentobarbital intravenously, supplemented by ether, was used for the anesthetic. Through a midline incision, the appen-

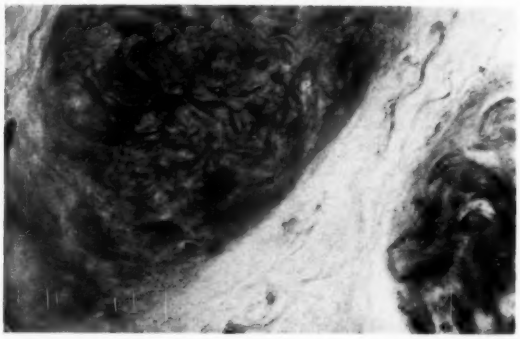

Fig. 13, left. Photograph of secondary lesions in rabbit 18, resulting from the intraperitoneal injection of the contents of the mucocele in rabbit 12.

Fig. 14. Photomicrograph of part of section through larger lesion shown in Fig. 13, showing myxomatous character of tissue. (Mallory's C. T. stain). ×445.

dix was irrigated with 60 cubic centimeters of normal salt solution and ligated near base with umbilical tape, tight enough to obstruct the lumen. Closure was made in layers.

A second operation was performed April 29, 1940. The same anesthetic was used. Through a midline incision the peritoneal cavity was opened, and several mucus-like deposits were seen on the surface of the omentum. The appendix was distended, red, and adherent to adjacent loops of intestine. It was about 8 centimeters long, 3 centimeters in diameter at the base and 2 centimeters in diameter at the tip (Fig. 6). There was a pin-head size opening near the base through which clear mucus could be forced by pressure. A large bulb-shaped, cystic tumor, about 7 by 6 centimeters in size was found between the great omentum and the mesentery of the small intestine (Fig. 6). There were several large retroperitoneal lymph nodes. The liver and spleen were normal except for a pin-head size nodule in the capsule of the liver.

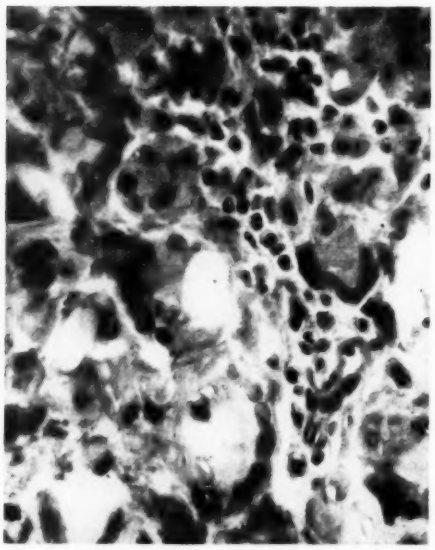

Fig. 15. Photomicrograph of part of section through secondary lesion in rabbit 17, resulting from intraperitoneal injection of emulsion of secondary deposits found in rabbit 12. Note the apparent incompletely formed gland tubules. (Mallory's C. T. stain). ×535.

Microscopic sections of the appendix showed the seromuscular coat to be markedly thickened while the middle or lymphoid layer was proportionally thinner, the lymphoid follicles assuming an oval shape, parallel with the long axis of the appendix. The inner or mucous layer was of about the same thickness as in the normal appendix. The glands and the mucin producing epithelial cells appeared quite active and normal. The three coats were of about equal thickness, in contrast to the normal condition, and the total thickness of the appendiceal wall was much less than that of the normal rabbit appendix (Fig. 5).

The large, bulb-shaped secondary tumor contained a thick, white, viscid fluid, consisting of mucus and degenerated inflammatory cells. Sections were taken through three parts of its wall. One section (Figs. 7 and 8), through the thinner part of the wall, showed the latter to consist of mature connective tissue infiltrated with lymphocytic cells, especially toward the inner surface, where there were many degenerated red blood cells and leucocytes. Just external to this surface, the cellular infiltration consisted of large mononuclear cells, some histiocytes, occasional foreign-body giant cells, and isolated epithelium-like cells. A section (Fig. 9) through the thicker part of the wall showed the latter to consist of very young connective tissue, some of it distinctly myxomatous in character. The cellular infiltration was more marked, the cells being mainly large mononuclears (plasma cells) with a liberal sprinkling of eosinophils. Near the inner surface, there were many partially degenerated red blood cells and leucocytes. Finally, a section (Fig. 10) through the neck of the tumor again showed a more mature type of connective tissue in the wall, which was very vascular.

*Results of intraperitoneal injections.* Since secondary deposits resulted from spontaneous rupture of mucoceles of the appendix, it was considered feasible to attempt the production of

pseudomyxomata peritonei by intraperitoneal injections of the contents of mucoceles and of secondary deposits into other rabbits. Because of excessively hot weather during the later period of the experimental work, 6 animals were lost from heat exhaustion. Nine other animals were used in this group of experiments; 7 injected with the contents of mucoceles and 2 with an emulsion of the contents, or of the contents and wall, of secondary deposits. Of the 7 animals injected with the contents of the mucoceles, 5 were injected with the whole contents or residue and 2 with the filtrate after passing the contents through a Seitz filter. Neither of the latter developed lesions, but 3 out of the 5 injected with the whole contents or residue showed typical pseudomyxomatous deposits in the peritoneal cavity (Figs. 13 and 14). The 2 animals, injected with an emulsion of the contents or of the contents and wall of secondary deposits, both developed pseudomyxomatous lesions of their own (Fig. 15).

*Other types of experiments.* A few variations in technique and findings may be noted. In one rabbit, the appendix was severed at the base between ligatures, the blood supply having been preserved and the lumen irrigated, as in the other animals. However, the animal died in one week of acute appendicitis and general peritonitis. In another, a seton thread was introduced into a mucocele of the appendix at the second operation purposely to permit leakage. However, at the next operation, this opening had sealed over and no secondary deposits had resulted. In still another animal, a gross opening was made in the appendix. This resulted in peritonitis and death in a few days. The contents of one mucocele were injected intravenously into another rabbit without any demonstrable result. One rabbit, which had developed secondary deposits after the intraperitoneal injection of the contents from the mucocele of another rabbit, showed a disappearance of the lesions upon secondary exploration several weeks later. A second injection was attempted, but the animal died of heat exhaustion. This experiment would indicate the production of an immunity reaction and recalls the tendency of some pseudomyxomatous lesions in the human to disappear after removal of the primary lesion.

*Contents of mucoceles and secondary deposits of experimental animals.* The material recovered from the mucoceles and secondary deposits varied in consistency from that of a clear, thin, viscid fluid to that of a thick, transparent or translucent, gelatin-like substance, depending upon the degree of inspissation which in turn seemed to depend upon the time elapsed since ligation. When there was much inflammatory reaction with leucocytic infiltration, the material was more opaque and white in color, resembling cream or putty according to the amount of fluid present. This was especially true of the secondary deposits, only a few of which were transparent in character. Chemically, the material was mucous in character, as shown by reduction tests and mucicarmine staining reactions. Bacteriologically, the contents of the mucoceles showed many small gram-negative (colon) and large gram-positive bacilli on smears and cultures. Hanging-drop preparations contained large sausage or balloon shaped bodies in which double, spherical objects were inclosed, like two peas in a pod. This picture could not be demonstrated in stained preparations. The contents of the secondary pseudomyxomatous lesions showed no organisms on direct smears and were sterile on cultures.

*Microscopic picture.* The histopathology of the appendices and secondary deposits in the experimental animals presents many interesting observations and opens up several new problems, the details of which will be considered in a later paper. In the smaller and younger specimens of mucoceles, the epithelial cells show little change but, in the older and larger specimens, the epithelial cells may become compressed and flattened by the pressure of the contents within the lumina, and eventually undergo atrophy and disappear. The most striking change, however, is in the middle layer. The normally thick layer of lymphoid tissue becomes much thinned out and the axis of the lymph follicles becomes parallel to the long axis of the appendix, due to pressure from within the lumen. The normally thin seromuscular layer may be thickened at first due to inflammatory reaction and fibrous tissue increase, but it later becomes thinned out by stretching. All the layers contain inflammatory cells, chiefly leucocytes with many eosinophils (Fig. 5).

The secondary deposits consist of an outer wall of young or more mature connective tissue, at times distinctly myxomatous in character. The central portions are usually necrotic, containing many inflammatory cells in various stages of disintegration. Toward the periphery of the necrotic central zone, these cells are better preserved and consist of many eosinophils intermingled with large mononuclear cells, occasional larger histiocytes and giant cells (Figs. 7 to 10, 14, and 15).

*Summary of animal experiments.* Mucoceles of the appendix were produced in rabbits in a large proportion of attempts, by a definite technique. When sufficient time elapsed, secondary deposits in the same animals often occurred by sponta-

neous rupture of, or extension through, the walls of the mucoceles. Secondary deposits were also produced in animals by the intraperitoneal injection of the contents of mucoceles or of emulsions of the contents and walls of the secondary deposits of other animals. However, the filtrates of these materials, after passing through a Seitz filter, were unable to produce lesions when injected intraperitoneally, indicating that the responsible substance was not filterable and was possibly cellular. The question is opened up as to whether the secondary deposits are the result of actual transplantation of viable cells, or the result of stimulation or irritation of cells *in situ*. This interesting speculation on cellular pathology merits further study.

## SUMMARY AND CONCLUSIONS

1. The literature on mucocele of the appendix and pseudomyxoma peritonei has been reviewed with particular reference to the clinical and pathological pictures. A personal case is described. The treatment, as recommended, consists of removal of the mucocele of the appendix and of radiotherapy of the pseudomyxomatous lesions when present.

2. In a series of animal experiments upon 26 rabbits, each operated upon 2 or more times, mucocele of the appendix and pseudomyxoma peritonei were frequently produced by a definite technique.

3. The most striking etiological factor in the production of mucocele is the obstruction at or near the base of the appendix, with a relatively clean but not necessarily bacteriologically sterile lumen.

4. A similar obstruction with a grossly infected lumen leads to acute appendicitis and gangrene.

5. Pseudomyxoma peritonei results from rupture of, or extension through, the mucocele wall and widespread dissemination of the mucous contents along peritoneal surfaces.

6. The question is raised as to whether the pseudomyxomatous lesions are the result of actual transplantation of epithelial cells from the appendiceal mucosa or the result of specific irritation of the serosal cells by the mucous contents. Further work will be necessary to answer this question.

7. In some of our experiments, there is evidence of the development of an immunity reaction, with the disappearance of secondary pseudomyxomatous lesions following the removal of the primary mucocele. Similar results have been reported in some clinical cases. In most of the clinical cases reported, however, the pseudomyxomatous lesions assumed malignant characteristics and led to a fatal outcome.

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# THE LATERAL APPROACH TO A DIVERTICULUM OF THE ESOPHAGUS

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THE most usual of the diverticula of the esophagus is the one which appears in the midline of the posterior wall just below the pharynx, and for this reason it is sometimes called a pharyngoesophageal diverticulum. It is a pulsion or hernial sac and protrudes through a weak triangular area left by the fibers of the constrictor muscle as they pass around the back of the esophagus. It starts as a small pit or depression of the mucosa which gradually enlarges and, after it has extended beyond the wall of the esophagus, it impinges on the curving anterolateral wall of the vertebrae and, aided by gravity, begins to extend downward. Because the esophagus in this region is usually to the left of the midline the diverticulum is found most frequently on the left side of the neck.

The symptoms are exactly what one might expect in a growth of this nature, and they increase in severity as the sac increases in size. At first there is a little hesitation in the customary effortless act of swallowing; gradually this becomes more pronounced, and later actual difficulty may develop. Gurgling while drinking may be quite embarrassing to the patient and at times splashing can be heard. Food which has been swallowed some hours previously and thought to be well on its way may suddenly reappear in the patient's mouth when he lies down or leans over. As the size of the sac increases the weight of its contents gradually pulls it beneath the pharynx so that the stoma of the sac comes to lie directly in line with the superior or proximal end of the esophagus. Food then passes directly into the diverticulum and that portion of the esophagus which lies next to the diverticulum is compressed and this interferes with the easy passage of the food into the stomach. When this stage is reached actual starvation may develop, and, if the diverticulum is large enough to press on the trachea, difficulty in breathing may be present.

Palliative treatment is not very successful. The patient learns early that by pressing on the side of his neck he can help himself swallow, or that he can empty a sac which has become uncomfortably filled. The condition, however, is slowly progressive and surgery is the only form of treatment which holds out any hope of relief.

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## ANATOMY

A surprising amount of anatomy is concealed within the small circle of the neck. Beneath the skin and platysma the sternomastoid is our main landmark. Medial to the anterior border of this muscle lies the carotid sheath with its contents, the carotid artery, the jugular vein, and the vagus nerve. Slightly posterior but almost in the same plane lie the so called ribbon muscles, the sternohyoid and the sternothyroid. In the midline and posterior to these muscles lies the trachea with the isthmus of the thyroid lying over the anterior surface and the lobes lateral to it. Posterior to the trachea is the esophagus and the diverticulum with which we are now concerned appears on its posterior surface and thus lies just anterior to the

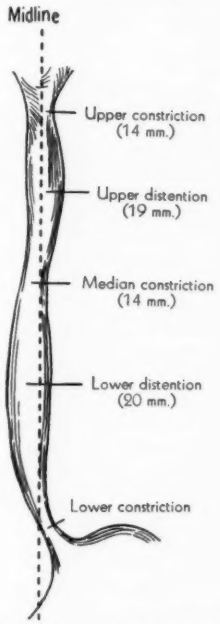


Fig. 1. Outline of the esophagus, showing the curvature to the left in the neck.

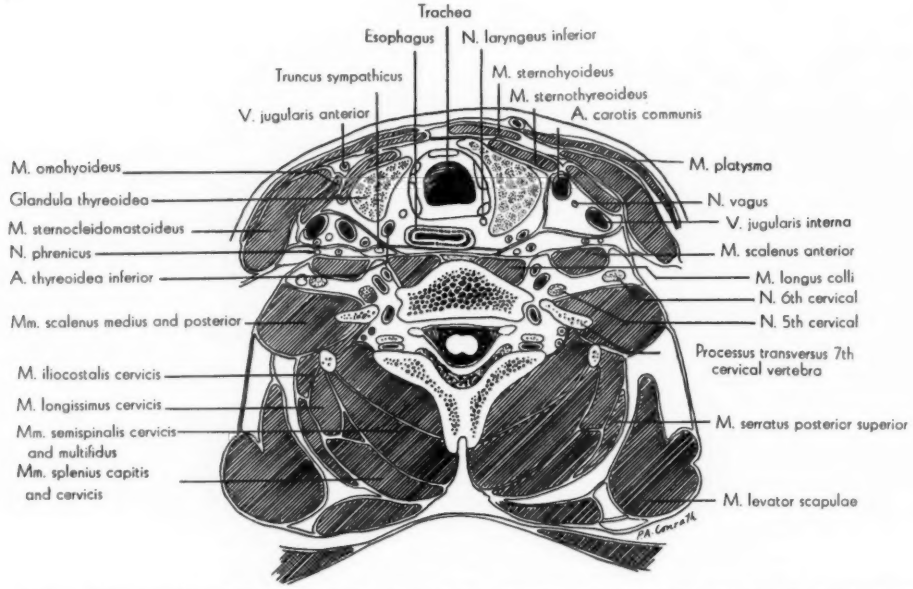


Fig. 2. Cross section of the neck at the level of the seventh cervical vertebra showing the fascias and structures involved in both routes to the diverticulum. (Modified from Eycleshymer and Schoemaker.)

cervical vertebrae. Several other structures should be mentioned, namely the blood supply to the thyroid, the recurrent nerve, and the omohyoid muscle which runs diagonally across the neck from the hyoid to the shoulder.

### OPERATION

*The anterior approach.* The incision is made along the anterior border of the sternomastoid muscle. The sternomastoid with the carotid sheath is retracted laterally, while the ribbon muscles and the thyroid gland are retracted medially. Usually the omohyoid muscle is divided. The recurrent nerve is identified so as to avoid any possible damage to it. And finally the esophagus is identified and the diverticulum found and dissected free. These, very briefly, are the steps taken in the operation commonly used in the excision of a pulsion diverticulum of the cervical portion of the esophagus.

### POSTERIOR APPROACH

Several months ago a patient came in complaining of dysphagia, regurgitation of food, gurgling upon drinking, and dyspnea. A diagnosis of esophageal diverticulum was made and confirmed by the x-ray. During the examination there came to mind a fact frequently demonstrated in the anatomy laboratory, namely that abscesses in or near the cervical vertebrae almost invariably follow along the prevertebral fascia and point at the side of the neck posterior to the sternomastoid muscle. Continuing this thought it began to look as though it might be more logical, instead of the more usual complicated approach in front of the sternomastoid, to make an incision posterior to this muscle and use the prevertebral fascia as a guide to the region between the esophagus and the vertebral column. Before an operation was attempted, however, an anatomical comparison of the two approaches was made on the cadaver. Four dissections were done, two anterior and two posterior to the sternomastoid muscle. Cross sections of the neck were also examined and the conclusion was reached that the posterior approach was not only simpler and quicker but was considerably safer than was the anterior approach.

This posterior approach is based on planes of cleavage as determined by the fascial planes of the neck. The deep fascia as it is followed from behind the neck toward the front is found to divide at the posterior border of the sternomastoid to enclose this muscle, and then it passes on to enclose the omohyoid and the ribbon muscles in front. Near the posterior border of the

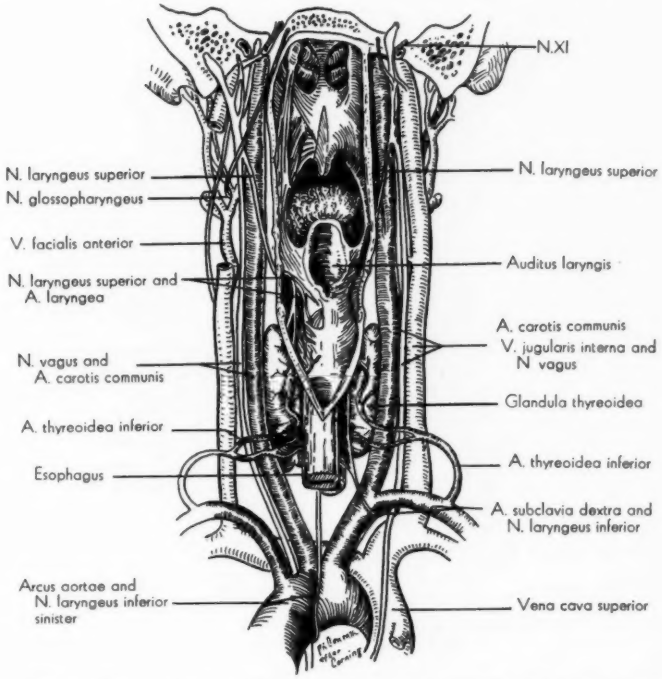


Fig. 3. The structures which lie anterior to the prevertebral fascia, viewed from behind.

sternomastoid, the inner sheath of this fascia again divides to form the prevertebral fascia which passes directly medialward between the esophagus and the cervical vertebrae. Behind the prevertebral fascia lie the vertebrae, the vertebral muscles and the nerves of the brachial plexus, which, however, emerge from behind the scalenus anterior and are thus amply protected. The phrenic is the only nerve running down the anterior surface of the scalenus. Anterior to the prevertebral fascia are the soft vital structures of the neck, the esophagus, the trachea, the thyroid with its blood supply, the recurrent nerve, and the carotid sheath which is a triangular space, the lateral wall of which is formed by the medial portion of the sheath of the sternomastoid, the medial wall is formed by the pretracheal fascia which passes medialward anterior to the trachea enveloping the thyroid as it does so, while the posterior wall is formed by the prevertebral fascia.

An incision made along the posterior border of the sternomastoid and deepened along the posterior surface of the prevertebral fascia will lead directly to the region behind the esophagus, and the operator will have the soft vital structures of the neck safely in front of this incision instead of having to dissect down between them. The posterior border of the sternomastoid is grasped by forceps and retracted gently forward and medially carrying with it the carotid sheath. Posterior to this muscle the prevertebral fascia can easily be felt and by blunt forceps and finger dissection it is followed medially. As the midline of the neck is reached the fascia will be found to become quite friable so no difficulty should be experienced in breaking through it to the esophagus. The diverticulum can then be found and dealt with as conditions dictate. If the diverticulum is large and has descended quite low in the neck or even into the thorax the lower end of this wound will be quite near the midline, thus affording ample room for dissection. This is a distinct advantage since with the anterior approach the lower part of the incision becomes constricted with the approach of the sternomastoid and carotid sheath toward the midline. There is so much more room with this incision that one may get right down behind the subclavian, and

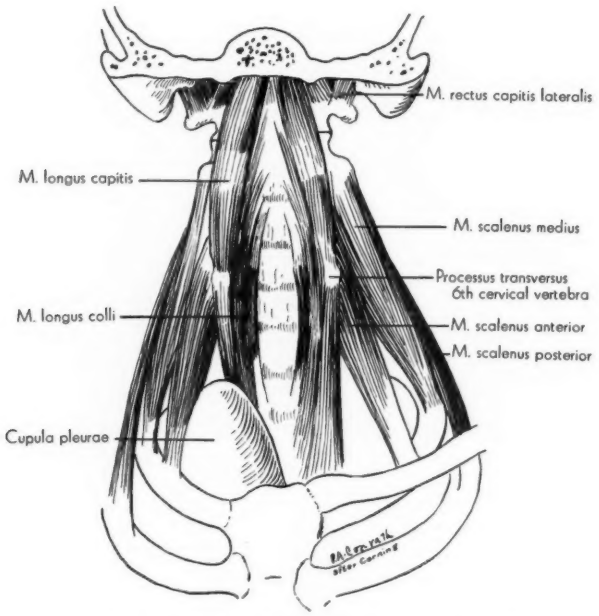


Fig. 4. Structures lying posterior to the prevertebral fascia.

it would seem to be an excellent site for the exteriorization of the esophagus in cancer of the distal end.

The disadvantages are few. The distance from the posterior border of the sternomastoid to the midline of the neck may be slightly greater than it is from the anterior border, but the directness of the approach, the freedom from dealing with vital structures, and particularly the roominess at the lower end of the incision more than make up for it. There should be no apprehension about disturbing the phrenic nerve as it lies snugly against the scalenus muscle and is not attached to the prevertebral fascia. The spinal accessory nerve may be cut if the upper end of the incision is carried too high, but this can usually be avoided. The branches of the superficial cervical nerves as they emerge from the posterior border of the sternomastoid can also be avoided, and probably no more of them will be severed with this incision than with the other.

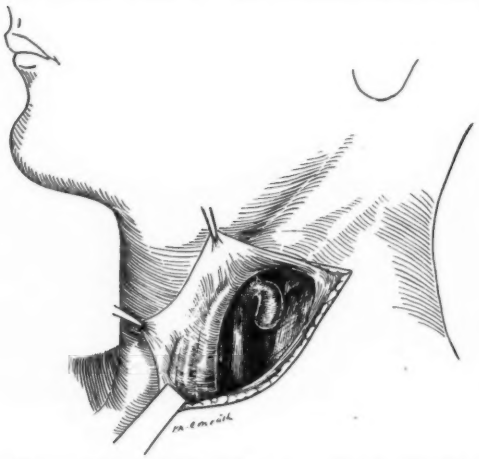

Fig. 5. View of the diverticulum through the posterior or lateral incision.

Throughout this paper the terms "posterior approach" and "anterior approach" have been used because of the reference to the sternomastoid. The "posterior approach" lies well to the lateral side of the neck and the dissection leads directly medially and for this reason the term "lateral approach" might be more descriptive.

A rather complete search of the literature as far back as 1895 has failed to reveal the use of anything but the usual anterior incision. If this lateral incision has been used before it has either

not been reported or has been missed by the author.

This lateral incision appears to be an excellent approach to the cervical portion of the esophagus and I believe warrants the consideration of the men who might use it.

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# A STUDY OF THE MOTILITY OF THE INTACT UTERUS AT TERM

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CONTRARY to the general trend of reports during the last two decades, two recent papers have presented direct evidence for the hormonal nature of the oxytocic principle of the hypophysis. Haterius and Ferguson (1938) demonstrated powerful and prolonged augmentation of uterine activity in rabbits shortly after parturition as a result of electrical stimulation of the pituitary stalk. The response was elicited after all probable nerve paths from the hypothalamus to the uterus were cut, but was not obtained after destruction of the pituitary body. Chang, Lim, Lu, Wang, and Wang (1938) reported increased oxytocic activity in the blood of nonpregnant bitches as a result of electrical stimulation of the central ends of the vagus nerves. Their blood and extracts were tested on isolated guinea pig uteri.

In his recent monograph, Reynolds (1939) has criticized the conclusions of Haterius and Ferguson on the grounds that the augmentation of uterine activity might have been due to the small and transient rises in blood pressure which occurred at the same time. In conversation Dr. Reynolds has offered another criticism, namely, that certain devious nerve paths from the hypothalamus to the uterus might have escaped section. He suggested that crushing the neck, leaving the carotid arteries and jugular veins as the only connection between the head and the trunk, would be a more convincing way to rule out nervous transmission.

The experiments presented in Section I of this paper were designed to test the objections to the experiments and conclusions of Haterius and Ferguson and to extend the observations to another species, the cat. The results support unequivocally the conclusions that direct stimulation of the pituitary stalk can liberate an oxytocic hormone. Section II contains certain observations on the motor reactions of rabbit and cat uteri near the time of parturition which suggest mechanisms which may control the secretion of the oxytocic hormone in the intact animal and the movements of the uterus during parturition.

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## SECTION I

*Methods.* In all experiments cats or rabbits 2 to 48 hours after parturition have been used. Uterine contractions were usually recorded by a Cushny myograph (1906) attached at two points on one horn about an inch apart along the longitudinal axis. Another method of recording often used simultaneously with the Cushny myograph was cannulation of the horn, either through an incision in the upper part of the vaginal wall and then through the cervix or through an incision in the uterine wall itself. The uterus was then distended with saline and the fluctuations in pressure recorded by a stiff tambour. The degree of activity recorded by this method depended somewhat on the degree of distention, but the changes in activity in response to various stimuli were very similar to those recorded by the myograph.

The animals were anesthetized with a mixture of 1 per cent chloralose in 10 per cent urethane, given in the amount of 4 cubic centimeters per kilogram intravenously to the rabbits and intraperitoneally to the cats. This was supplemented by ether for the operative procedures, which consisted of tracheotomy, isolation of the carotid arteries, external jugular veins, and vagus nerve trunks, and trephining of the skull. A femoral vein and artery were cannulated for injections and the recording of blood pressure respectively. The apparatus for recording uterine contractions was

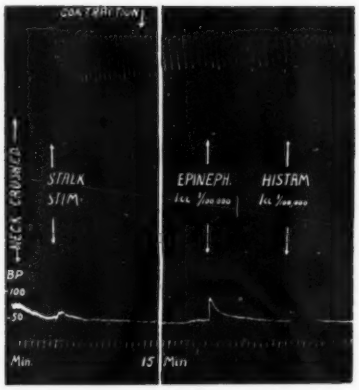


Fig. 1. The upper tracing shows uterine contractions in a rabbit 24 hours post partum recorded by the Cushny myograph. The lower record is of blood pressure in the femoral artery. The powerful and prolonged contractions of the uterus elicited by electrical stimulation to the pituitary stalk after the neck was crushed contrast strongly with the effects of epinephrine and histamine injected intravenously.

introduced through an incision in the midline or in the flank. The head was then mounted in a special headholder. This device orients the head by fixing three points, the two external auditory meatuses and the necks of the central incisors, or, in the case of cats, the maxillary bone just above the central incisors. Bipolar electrodes are carried on a rack and pinion adjustment (giving movement in three dimensions), and attached to the frame of the headholder. The electrodes are sighted on the midline over the trephine hole and set at a mark on the anteroposterior scale which has been found to lie directly over the middle of the pituitary fossa. The electrodes may then at the appropriate time be inserted to a depth indicated on another scale and which has been found to bring the tips of the electrodes about 1 millimeter above the roof of the pituitary fossa. It has been found empirically that the electrodes are in proper position when stimulation produces a bilateral flutter of the eyelids and twitching of the whiskers. The electrodes were made of No. 22 gauge nichrome wire, lacquered to the tips and separated by only 0.1 millimeter. They were excellent for applying localized stimuli with the inductorium, but for destroying the pituitary body by direct current the lesions produced were too localized. Wires separated by about 0.5 millimeter were better. As in previous work, the vibrator of the inductorium was weighted to diminish the frequency of the breaks to about 8 per second.

For crushing the neck obstetrical cranioclastic forceps were used. The jaws were placed in position and, at the proper time, screwed tightly together leaving only the carotid arteries, jugular veins, and a flap of skin as the sole functional connections between the head and the trunk. Autopsies showed that the spinal cord was completely severed by dislocated vertebrae at the level of the third or fourth cervical segment. Artificial respiration was started after the neck was crushed. The blood pressure, after an initial rise of variable size, gradually fell to shock levels. In most of the later experiments the fall in blood pressure was delayed by continuous infusion of saline, or saline with 6 per cent gelatine, with or without the aid of ephedrine (about 2 mgm.) injected intravenously. This dose of ephedrine had no effect on the movements of the uterus and often by itself was sufficient to maintain the blood pressure at a level high enough to sustain active uterine movements, namely 50 to 70 millimeters of mercury.

*Procedure.* Typical experiments were conducted as follows. After the preparatory operations the uterine contractions were recorded for ½ to 1 hour. The contractions were usually quite infrequent, provided the uterine muscle was only slightly stretched by the recording apparatus.

In some experiments certain drugs were injected during this period to compare their effects with those of stalk stimulation and of pitocin or pituitrin. In other experiments the drugs were injected after the effects of pitocin and stimulation had been elicited. The drugs used were epinephrine, acetylcholine, and histamine since it was conceivable that the electrical stimuli in the brain stem might release one or more of these substances. It may be said here that none of these substances produced effects at all comparable to the effects of stimulation or of pitocin, as Figures 1 and 2 illustrate. The complex effects of epinephrine are discussed in Section II. Acetylcholine in doses sufficient to lower the blood pressure by 40 to 50 millimeters had scarcely any effect on uterine motility; somewhat larger doses gave complex effects like those of epinephrine.

In some experiments the initial control period was followed by an injection of pitocin, in others by a stimulation of the stalk. In others again the crushing of the neck was done immediately. After the crushing, a further period of 15 to 25 minutes was allowed to elapse while the effects of this procedure on the uterine movements was observed. As a rule the crushing of the neck by itself had little effect on the uterine contraction and never evoked a sustained increase in activity.

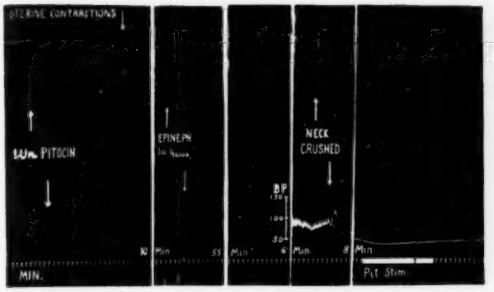


Fig. 2. Uterine contractions induced by pitocin in a cat 8 hours post partum before the crushing of the neck are shown for comparison with the contractions induced by stimulation of the pituitary stalk after. A common effect of epinephrine is also illustrated.

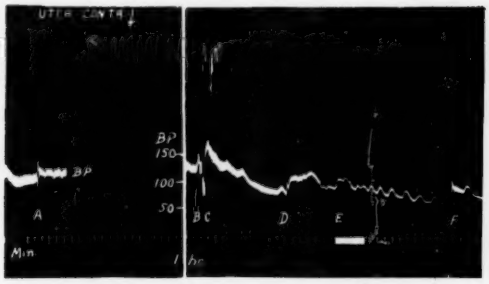


Fig. 3. Cat 24 hours post partum. At *A*, 1 unit of pitocin was injected intravenously. At *B*, the neck was crushed, and at *C* the vagi were divided. At *D*, 20 cubic centimeters of saline was injected intravenously with practically no effect on uterine motility, although the rise in blood pressure was greater than that produced by pituitary stimulation at *E*. Rises in blood pressure with each uterine contraction are well illustrated. At *F*, another 20 cubic centimeters of saline was injected without effect on the uterine motility. The fall in blood pressure was minimized by an injection of 2 milligrams of ephedrine before the neck was crushed.

*Observations.* In consecutive experiments on 6 rabbits and 5 cats, stimulation of the pituitary stalk after the neck was crushed, in every case, produced a change in uterine contractions similar to that produced by pitocin injected intravenously. The most characteristic features of the response in both species were the increased frequency of contractions and the long duration of the increased activity, a matter of 1 or 2 hours. In both cats and rabbits the response to stimulation of the stalk was about equal to the effect of 0.5 unit of pitocin.

In 3 cases after a further period of an hour to an hour and a half after the neck was crushed, a second stimulus gave a similar, but not quite so great, response.

In 1 other case in which a second stimulus was attempted, no response was obtained, probably because of the poor condition of the uterus after a long period of low blood pressure. In this case the injection of 1.0 unit of pitocin a few minutes later also failed to stimulate the uterus.

Associated with the uterine response to stimulation of the stalk there was usually a small rise in blood pressure which raised the question as to whether a pressor hormone was liberated as well as an oxytocic one. In this connection it should be noted: (a) that one of the illustrations (Fig. 2) shows only a very slight rise in blood pressure which follows the onset of the uterine contractions; (b) that in all tracings as the uterine activity subsides from the tetanic level each separate contraction is associated with a rise in blood pressure; (c) that closer analysis of the tracings shows that these periodic rises of blood pressure follow, rather than precede, the uterine contractions, which fact suggests that the blood pressure rise is a mechanical consequence of the uterine contractions, as noted by Franklin (1935). In 1 experiment stimulation of the stalk was followed by an injection of 1 unit of pituitrin and then of 1 unit of pitocin. The pituitrin gave a larger rise in blood pressure than did stimulation of the stalk, but actually diminished uterine motility due presumably to its vasoconstrictor action in the uterus. The pitocin produced simultaneously with uterine contraction a small rise in blood pressure about equal to that obtained on stimulation of the stalk. These observations suggest that the hormone liberated by stimulation of the stalk in these animals has little pressor action and resembles pitocin more than whole pituitrin.

*Evaluation.* The rises in blood pressure accompanying the uterine response were suspected by Reynolds of causing the response. Although Figure 2 by itself is sufficient to rule out the possibility, other considerations pointing to the same conclusion should be mentioned. A rise in blood pressure is illustrated in Figure 3 at *D*, which was produced by the slow injection of 20 cubic centimeters of normal saline, while the blood pressure was falling after the neck was crushed. Although the rise in blood pressure thus produced was greater than the rise produced shortly after by the stimulation of the stalk, no augmentation of uterine activity resulted from the saline injection.

Another simple consideration discounting the possibility that the rise in blood pressure caused the uterine response is the fact that the uterus was relatively inactive when the blood pressure was high, before the crushing of the neck, but

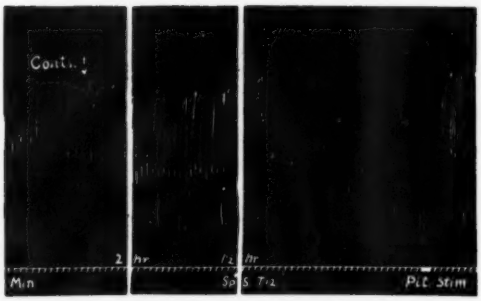


Fig. 4. This tracing illustrates the gradual increase in uterine activity in a rabbit about 24 hours post partum, during 2 hours of recording without interference, together with the decline in activity following spinal transsection. The integrity of the uterus and pituitary gland were demonstrated at the end by electrical stimulation of the pituitary stalk. The decline in uterine activity is attributed to interruption of afferent impulses from the lower cord maintaining secretion of oxytocic hormone.

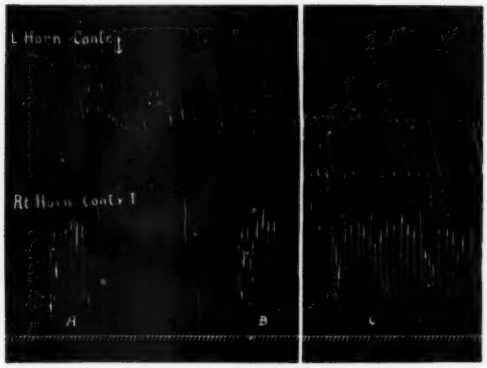


Fig. 5. The contractions of the left uterine horn of a rabbit are recorded by a Cushny myograph. The contractions of the right are recorded by a tambour only when the horn is distended with saline as at *A*, *B*, and *C*. The distention of the right increases the movements of the left horn before destruction of the hypophysis, *A* and *B*, but not after, *C*.

greatly augmented after stimulation of the stalk, although the blood pressure was lower than before the crushing of the neck.

Many observations have indicated that a very low blood pressure can depress the activity of the postpartum uterus. Rises in blood pressures may restore activity suppressed in this way, but they have not been observed to initiate activity.

SECTION II

The experiments in this section had the object of identifying characteristic reactions of the uterus near the time of parturition. With typical reactions identified, it became possible to assess the importance of secretion of oxytocic hormone and of purely nervous factors in each reaction. The results have provided new viewpoints on the mechanism and onset of parturition.

*Methods.* Rabbits, 8 to 48 hours after parturition, were used unless otherwise stated. The anesthetics, operative procedures, and methods of recording uterine motility were usually those described in Section I. For visual observations of the uterus the abdominal cavity was exposed by a special retractor and protected from drying by a sheet of cellophane. The stimuli most frequently tried were dilatation of the vagina, the cervix, and the uterine horn. The vagina was dilated by inflating a finger cot on the end of a glass tube inserted through the os vaginae, the cervix by a glass dilator inserted through an incision in the vagina. The uterine horn was usually dilated with saline through a cannula inserted through an incision in the wall of the horn. In later experiments a finger cot was used. In no case did the size of any of the dilators exceed that of a fetus at full term.

*Observations.* When the abdomen was opened 8 to 24 hours after parturition the uterus was nearly always large, flabby, and inactive. On exposure to air it contracted but even after attaching the recording apparatus the contractions were usually feeble and infrequent. During the subsequent half hour or less, the contractions gradually increased in strength and frequency until a level of activity was reached which was maintained fairly uniformly for as long as observations were continued without interference: a matter of 4 hours in 1 case and of 2 hours or more in many other experiments.

The slowly mounting activity of the first half hour was attributed at first to the elimination of the ether used in the operation or of the basal anesthetic. It soon became evident, however, that readministration of ether until all reflexes were abolished had no immediate depressing effect on the uterine contractions (confirming Cushny, 1906), nor had the administration of more chloralose and urethane. If deep anesthesia were maintained for a quarter of an hour or more, a slow decline in uterine activity developed. These observations suggested that the effect of the anesthetic might not be directly on the uterus or on purely nervous reflexes, but on reflex maintenance of tonic secretion of oxytocic hormone, or perhaps on a tonic secretion of oxytocin dependent not on afferent nerve impulses but on "spontane-

ous" nervous activity in the brain stem. That oxytocic hormone is important for the maintenance of a high level of activity has been abundantly indicated by the fact that destruction of the pituitary body by electrolytic burns has consistently led, both in these experiments and in those of Haterius and Ferguson (1938), to a gradual decrease in the uterine activity in a matter of an hour or so.

To test whether tonic secretion was reflexly maintained by impulses from the pelvic region, the spinal cord was transected in 7 experiments at the twelfth thoracic segment while the uterine activity was high. In every case the uterine activity gradually decreased and within an hour and a half the contractions were very infrequent (Fig. 4). The decline in activity resembled the decline after an injection of pitocin. In 3 experiments the functional integrity of the uterus was demonstrated at the end of this period by an injection of pitocin (0.2 to 0.5 unit). In the 4 others the integrity of both the uterus and the hypophysis was demonstrated by electrical stimulation of the pituitary stalk. Each time a vigorous response of the uterus was obtained. It appears then that afferent impulses from the lumbosacral cord are important in maintaining a tonic secretion of oxytocic hormone.

*Uterine dilatation.* The main source of the afferent impulses maintaining secretion of hormone under the conditions of these experiments appears to be the stretching of the uterine horn by the recording apparatus. In 3 experiments, relaxation of the tension on the uterus by bringing the arms of the Cushny recorder closer together resulted in a gradual decrease in the frequency of the contractions. Stretching the horn again brought a gradual decrease in frequency. No changes in frequency were obtained by changing the stretch on the uterus after the pituitary had been destroyed, even before the activity of the uterus had declined appreciably. The contractions merely became less and less frequent.

It may be contended that in these experiments changes in stretch altered merely the irritability and contractility of the stretched muscle. If this possibility is not thought to be adequately excluded by the ineffectiveness of stretching after destruction of the pituitary, it appears to be by experiments in which stretching one horn brought about gradual increase in frequency of the other. In 6 experiments one horn was dilated with saline, while the contractions of the other were recorded with the Cushny myograph. In 3 cases in which the preliminary activity was low, definite augmentation of activity of the unstretched horn was

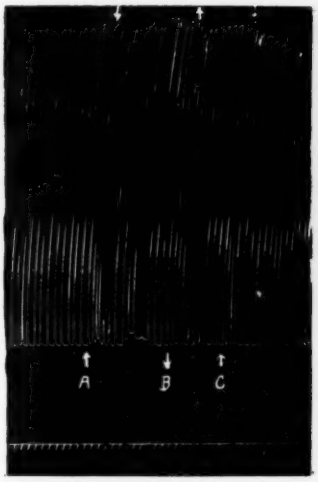


Fig. 6. Simultaneous record of the contractions of the right and left uterine horns in a rabbit are shown. The top record is by the Cushny myograph, the lower by a tambour connected to the left horn which is filled with saline. At *A* a vaginal dilator was inserted and inflated. At *B* the dilator was slowly pulled out through the os, producing another response. Both are qualitatively similar to the effect of 1 cubic centimeter of epinephrine 1:100,000 injected intravenously at *C*. *Time intervals 1 minute.*

observed. The effect was abolished by destruction of the pituitary (Fig. 5). In 3 other cases no definite augmentation was observed, but in all of these the preliminary activity was very great, due perhaps to the stretch imposed by the cannula in the uterine horn. This factor was not appreciated when the experiments were done. The slow augmentation and slow decline of activity on stretching should be distinguished clearly from an immediate effect of great dilatation of the uterine horn on its own contractions, with no immediate effect on the contractions of the other horn. This effect was an immediate increase in frequency with considerable irregularity, as if contractions were starting in various parts of the horn and interfering with propagated synchronous contractions.

*Vaginal dilatation.* In each of 12 experiments, dilatation of the vagina produced a definite change in the uterine activity. The nature of the change depended somewhat on the circumstances and sometimes appeared to have two components, producing some mutual interference. The most prominent component may be called the "immediate biphasic reaction." This reaction was elicited in pure form (a) in the more deeply anesthetized animals, (b) after destruction of the

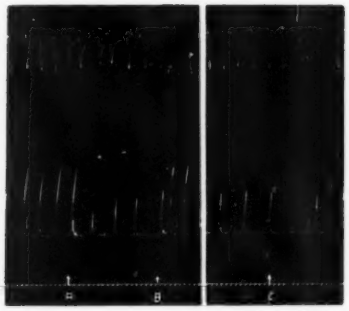


Fig. 7. A record of contractions from both uterine horns in a cat is shown. At *A* a vaginal dilator is inflated; at *B* deflated. At *C*, 1 cubic centimeter of epinephrine 1:100,000 is injected intravenously.

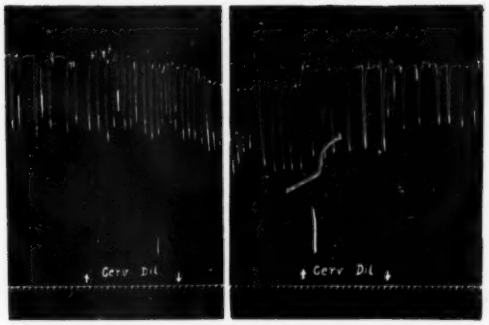


Fig. 8. The effect of dilation of the cervix before destruction of the hypophysis is shown in the first section, and its lack of effect after destruction of the hypophysis in the second.

pituitary, (c) after cord section at the twelfth thoracic segment; hence, it is probably reflex, involving not more than the lumbosacral cord. It consists of an immediate increase in frequency lasting for 3 to 5 minutes, followed by decrease in frequency (below the control frequency) lasting 3 to 10 minutes. The changes in amplitude are not characteristic or reproducible even in the same animal (Fig. 6). The amplitude may increase or decrease in either phase. This mixed response resembles the characteristic response of the parturient uterus of both cat and rabbit to epinephrine. An atypical but instructive example is illustrated in Figure 8 in which a cat uterus responds to both vaginal dilatation and epinephrine with a biphasic response in which, however, the phase of decreased frequency (and amplitude) comes first. From the foregoing evidence it may be postulated for the time being that the immediate biphasic response is a reflex, involving the adrenergic innervation of the uterus. A similar reaction is often observed, not only on inflation of the vaginal dilator, but also on the insertion and removal of the dilator through the os vaginae.

The second component of the response to vaginal dilatation may be called the "slow augmentation reaction." In lightly anesthetized intact animals this reaction is sometimes superimposed on the immediate biphasic reaction, with the result that the uterine contractions are somewhat irregular, but tend to increase in frequency and amplitude. The augmentation outlasts the dilatation and subsides slowly, like the effect of stretching the horn. It has not been obtained after destruction of the hypophysis or after section of the spinal cord. In any case it is not obtained as consistently by stretching the vagina as by stretching the uterine horn.

A third effect of vaginal dilatation does not strictly concern the uterus but is of interest. It is a "bearing down" contraction of the abdominal muscles. It is feeble or absent in deep anesthesia and disappears after section of the cord at the twelfth thoracic segment. No attempt has been made as yet to determine the pathways of this interesting reflex. The adequate stimulus appears to be dilatation of the vagina or rectum. Stretching the cervix does not produce it.

A fourth effect of vaginal dilatation observed visually in 2 cases is a powerful contraction of the cervical region. This contraction quickly involves the upper end of the vagina and is propagated downward as an expulsive peristaltic wave.

*Cervical dilatation.* Stretching the cervix in 8 of 10 experiments has produced a uterine reaction of the slowly augmenting, slowly subsiding type. In each case the reaction was abolished by destruction of the pituitary or by section of the cord (Fig. 8). The 2 failures were earlier experiments in which the initial activity of the uterus was great. In 2 of the 8 experiments there has been a suggestion of an immediate biphasic component, but this might have been due to the manipulation of the vagina during the introduction of the cervical dilator.

The experiments to date give the impression that the reaction suggestive of release of oxytocic hormone is elicited most effectively by dilatation of the cervix, almost as effectively by the stretching of the horn, but only occasionally and feebly by the stretching of the vagina.

*Afferent vagal stimulation.* The claim of Lim and his co-workers that stimulation of the central ends of the vagus nerve in the neck liberates pressor hormone from the pituitary prompted a trial of this type of stimulation in the rabbit. In 3

of 5 experiments definite augmentation of uterine activity of the slowly augmenting, slowly subsiding, type was obtained. It is uncertain whether these results indicate a physiological afferent pathway through the vagi or merely represent an irradiation of intense activity in the brain stem.

*Evaluation.* In a study of the effects of epinephrine on excised rabbit uteri near the time of parturition, Bonnycastle and Ferguson (1940) stress the variation in the response of different parts of the uterus to epinephrine. They conclude that epinephrine is predominantly motor to the circular muscle at the cervical end of the uterus, and to a lesser degree to the circular muscle of the rest of the horn. The longitudinal muscle of the horn was less frequently stimulated than the longitudinal muscle at the cervical end, and indeed is often inhibited. The functional effect of epinephrine was deduced to be antiexpulsive: (a) by tending to make the cervical end the pacemaker for contractions of longitudinal muscle, (b) by promoting contraction of the cervix and other circular muscles, (c) by inhibiting synchronous contractions of the longitudinal muscle which must be the most powerful agent of expulsion. They contrast the nonexpulsive effects of the powerful contractions produced by epinephrine given to rabbits at term with the immediate expulsive effect of small injections of pitocin. On the basis of these experiments, it is suggested that the component of the response to dilatation of the vagina, which resembles that of epinephrine, is a mechanism for co-ordinating the emptying of the uterine horns. Dilatation of the vagina by the entry of a fetus would cause reflexly a contraction of the cervix and probably other effects on the horn, resembling those of epinephrine. Thus the emptying of the horns would be delayed until the vagina had been emptied.

## EVALUATION

The observations of this paper suggest some additions to current hypotheses concerning the onset and mechanism of parturition, at least in the rabbit. Stretching the uterus appears to maintain a tonic secretion of oxytocin. Whether this is true throughout pregnancy remains to be determined. In any case the effect would not be important because of the insensitivity of the uterus to oxytocin until the end of gestation (Knaus, 1926). As the sensitivity to oxytocin increased, contractions forcing the fetus against the cervix would increase and would be most likely to stretch the cervical region at a time sympathetic activity tending to contract the cervical region was at a low level. Stretching the cervix would augment the secretion of oxytocin and provide added impetus to expulsion, since the cervix itself is relatively insensitive to oxytocin (Newton, 1937; Bonnycastle and Ferguson, 1940). Expulsion of the fetus into the vagina might liberate even more oxytocin, but its main effect would be to cause contraction of the cervix and, by this and its other actions, to delay the expulsion of more fetuses till the vagina was emptied. The known factors are sufficient to explain the evacuation of several fetuses from a horn in orderly succession, starting with the lowest one. If oxytocin initiates contractions in the longitudinal muscle of all the ampullae, as it appears to from inspection, it is in the lowest ampulla that contractions, propagated toward the vagina, will be least likely to meet contractions propagated in the opposite direction, because of the insensitivity of the cervical region to oxytocin. In all the higher ampullae expulsive contractions are likely to be opposed by contractions starting below. In fact, the interampullary nodes are likely to be kept in fairly constant activity by contractions reaching them from both above and below, and might be expected to act like sphincters in high tone. With the lowest ampulla empty, and the stimulus of stretch thus removed, retrograde contractions opposing the expulsive contractions of the ampulla above would cease, or at least become less frequent, and allow it to empty in its turn.

Certain phenomena of parturition in the human may be interpreted rather plausibly in view of the findings of this paper. It is generally observed that labor pains increase in frequency and strength as the cervix dilates. They reach their maximum in the second stage when the cervix is fully dilated. It is plausible to suppose that in the human, as in the rabbit, stretching the cervix may augment the secretion of oxytocin. This may explain why a dilating bag or rimming of the cervix is so effective for inducing labor. Rupture of the membranes, forcing the presenting part against the cervix, may achieve the same result more slowly. Involuntary "bearing down" in the human is characteristic of the second stage of labor when the fetus is stretching the vagina: thus the adequate stimulus for bearing down may be the same in the human as in the rabbit.

The effect of epinephrine on uterine contractions in the human seems to be the same as in cats and rabbits. The records of Bourne and Burn (1930) taken during parturition show that 0.3 milligram of epinephrine given intravenously produces an initial augmentation of contraction followed by inhibition, resulting in a 10 minute pause in the midst of regular 5 minute pains, which may be utilized in obstetrics to perform versions.

SUMMARY

In Section I further evidence is presented that electrical stimulation of the pituitary stalk in rabbits and also in cats shortly after parturition liberates an oxytocic hormone.

In Section II the effects of stretching the uterine horn, cervix, and vagina and certain other stimuli on the uterine activity are analyzed. The evidence indicates that dilatation of the cervix augments uterine motility by reflexly liberating oxytocin. Dilatation of the horn, remote from the cervix, does so too, but less consistently. Dilatation of the vagina only occasionally releases oxytocin but consistently produces a complex change in uterine activity similar to the effects of epinephrine. It is suggested that vaginal dilatation reflexly delays the emptying of the horns until the vagina is emptied.

Aspects of parturition in rabbits and humans are discussed.

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# A STUDY OF THE BACTERIOLOGY OF THE CERVIX DURING PREGNANCY AND ITS RELATION TO PUERPERAL MORBIDITY

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A STUDY of the medical literature of the past 40 years reveals many articles dealing with the incidence of pathogenic organisms in the cervix and vagina of women during pregnancy and their importance as a contributing cause in increasing puerperal morbidity and mortality. It is now well known that the genital tracts of women harbor a variety of organisms which morphologically and culturally are identical with bacteria which do initiate pathological changes, although the incidence of such organisms varies greatly in reports of different observers. Most obstetricians agree that autoinfection from the cervix and vagina is a negligible factor in the causation of puerperal sepsis. Some indeed insist that it never occurs and that puerperal infection is always due to introduction of pathogenic organisms from without. However, most men of wide experience can recall patients who developed severe and fatal puerperal infection in which the most painstaking investigation revealed no possibility of exogenous source.

In 1898, after bacteriological examination of the vaginal secretion in 92 pregnant women, Williams (15) concluded that the usual pyogenic cocci were not present so that death from puerperal infection is always due to infection from without. He did admit the possibility, in very rare instances, that the vagina may contain bacteria which give rise to sapremia and putrefactive endometritis by autoinfection.

Bumm and Sigwart (1904) studied 103 women and, using solid culture media, were able to isolate aerobic streptococci in three-fourths of them prepartum, intrapartum, or postpartum. They believed that with better culture media (bouillon) streptococci would be found in the vaginal secretion of all pregnant women. They presumed that virulence was promoted by the streptococcus working in symbiosis with other organisms present and by change in local conditions making the locus ideal for proliferation and elaboration of toxin. Their study of the puerperia of these women led to the conclusion that there is no definite relationship between streptococci found prepartum and puerperal morbidity.

Fromme (1910) from his studies concluded that it was impossible to estimate the virulence of a specific strain of streptococci because of variation in individual resistance. He did not believe that the ordinary streptococcus strains which are found postpartum can gain in virulence nor that saprophytic streptococci found prepartum can result in puerperal infection.

Medalia and Walton (1912) studied 103 cases antepartum and postpartum and concluded: (1) hemolytic or nonhemolytic streptococci causing morbidity are not necessarily of exogenous origin; (2) autoinfection plays an equal rôle with exogenous infection as to frequency of sepsis but not as to its severity.

Fricke (1914) studied the vaginal secretion in 50 women awaiting delivery at the Hopkins Clinic using a variety of culture media. Streptococci were isolated from the vulva in 14 per cent, from the vagina in 8 per cent. In 47 prepartum women examined at home the percentages were 75 and 55 per cent, respectively. He attributed the 7 times greater incidence in homes to less personal cleanliness. One-third of the organisms were hemolytic.

Kantor and Pilot (1924) studied bacteriologically 96 prepartum women of various parity, with clinical follow-up in the puerperium of 67. They concluded that hemolytic streptococci are rarely present in the normal vagina and when present are not very virulent.

Eeles (1925) examined 31 primiparae and 39 multiparae and found the Bacillus coli in 4, Staphylococcus albus in 34, diphtheroid bacillus in 35, Staphylococcus aureus in 1. The streptococcus was found in 5 multiparae and in 6 primiparae. Only 1 was hemolytic.

White and Armstrong (1928) indicated that previous studies of the bacteriology of the cervix and vagina during pregnancy were inconclusive because no attempt was made to designate the type of streptococcus. In a study of 153 cases

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(141 primigravidae, 12 multiparae) they found aerobic streptococci 36 times, anaerobic 55 times. Only 34 of the combined groups exhibited hemolytic properties. No cases of true sepsis occurred in the women whose prepartum cultures had given positive cultures of Streptococcus hemolyticus. Of the 127 patients whose cultures were negative for Streptococcus hemolyticus there were 5 morbid puerperia and 1 typical streptococcic septicemia. In each of these latter, the Streptococcus pyogenes was cultured from the cervix and in the last one from the blood stream. Their results seemed to indicate definitely an exogenous origin for infection in puerperal sepsis.

Bryce (1928) studied cervical cultures in cases of fever following childbirth or abortion. He concluded that the presence of a number of organisms in the genital tract is usually associated with a mild type of disease. The isolation of one strain only may or may not be significant. The presence in pure culture of the Streptococcus pyogenes or the gonococcus appears to indicate the accession of invasive power which is associated with virulence. The work did not indicate whether the association of mild disease with the absence of streptococci means that these organisms have never been present either as pre-existing or introduced inhabitants or whether the resistance of the host has been sufficient to inhibit the development of virulence on their part.

The *Annals of the Pickett-Thompson Research Laboratory* (1929) record the following organisms as having been isolated from the female genital tract: Streptococcus pyogenes puerperalis, facultative anaerobic diplococcus, Staphylococcus albus, bacteria of coli group, Bacillus pseudotetanus, Bacillus aerogenes capsulatus, Streptococcus viridans, Streptococcus mitior, Streptococcus fecalis, Staphylococcus aureus, diphtheroids, yeasts, molds, pneumococcus, Micrococcus tetragenus, Streptococcus mitis, Streptococcus infrequens, Streptococcus equinus, Bacillus welchii, Doederlein's bacillus, enterococcus, Bacillus subtilis, and Bacillus mycoides.

DeLee (1929) stated that mild cases of autoinfection may occur occasionally; fatal cases are exceedingly rare.

Williams (16, 1930) concluded that while bacteriological research affords a certain amount of evidence in favor of the theoretical possibility of autoinfection, clinical observation speaks against it. Accordingly the occurrence of serious streptococcic infection should always be regarded as evidence of external infection.

Logan (1931) isolated streptococci 70 times in a study of 200 prepartum cases (35 per cent). Bacillus coli was isolated from 10 of the same group (5 per cent). None of the streptococci were hemolytic. Only 5 per cent of these patients had postpartum morbidity of the British Medical Association standard. There was an increase in puerperal morbidity incident to operative interference. Contrasting the puerperia of those with and without positive prepartum cultures led the author to conclude that the presence of a nonhemolytic streptococcus in the vagina during pregnancy has no apparent bearing on the production of puerperal sepsis.

Watson (4, 1933) states that the general consensus is that autoinfection is not common. It has been considered a possibility that autoinfection from the vagina or cervix may be the explanation of those cases of infection occurring in women on whom no internal examination has been made and who have had a spontaneous and unaided delivery.

Harris and Brown (1926) have shown that the fourchette and fossa navicularis contain a rich bacterial flora which may be carried into the female genital tract when vaginal and cervical cultures are taken. Adair et al. (1933) confirmed this conclusion.

This study was undertaken in an attempt to answer the following questions:

1. What is the incidence of pathogenic organisms in the cervix of pregnant women since previous publications give a wide divergence of results.
2. What is the relationship between cervical erosion and previous mild chronic cervicitis as contributing factors to the presence of these organisms?
3. What effect does parity have on this incidence?
4. Is there a seasonal variation in the presence of pathogenic organisms?
5. Has the stage of gestation an effect on the incidence?
6. Does the evidence support the occurrence of autoinfection?

Cultures were taken from the cervices of 275 consecutive patients admitted to the maternity clinic at the Pittsburgh Hospital. To eliminate the personal factor, all cultures were taken by two of the authors (E. A. C. and D. L. O'L.). The following technique was used: The labia were separated and the vestibule cleansed carefully with cotton pledgets soaked in 4 per cent boric acid solution; a sterile bivalve speculum was introduced, opened, and passed into the vagina so that the cervix was exposed without touching it; 2 cultures were taken; the cervix was then cleansed and inspected.

TABLE I.—RESULTS OBTAINED IN CULTURES MADE IN 275 PATIENTS

| | Aerobic | Anaerobic |
|---|---|---|
| Total no. cultures made | 275 | 167 |
| Organisms isolated | | |
| Staphylococcus albus | 182 | 84 |
| Staphylococcus aureus | | 1 |
| Staphylococcus citreus | 1 | |
| Staphylococcus hemolyticus | 2 | |
| Micrococcus flavus | 2 | |
| Pneumococcus | 4 | 1 |
| Micrococcus pharyngis siccus | 1 | |
| Micrococcus catarrhalis | 3 | |
| Micrococcus tetragenus | 4 | 2 |
| Large gram-coccus unidentified | 1 | |
| Diphtheroid bacillus | 15 | 13 |
| Friedlaender's bacillus | 2 | 1 |
| Bacillus lactis aerogenes | 1 | |
| Bacillus proteus | | 2 |
| Bacillus subtilis | 20 | 12 |
| Bacillus xerosis | 1 | |
| Bacillus coli communis | 4 | 5 |
| Bacillus coli communior | 4 | 2 |
| Bacillus pseudodysentericus | 1 | |
| Bacillus fecalis alcaligenes | 2 | 1 |
| Bacillus smegmatis | 3 | 2 |
| Gram positive bacillus unidentified | 1 | 2 |
| Gram negative bacillus unidentified | 1 | |
| Gram positive spore bearing bacillus | 2 | |
| Bacillus mesentericus | 1 | |
| Leptothrix | 6 | 28 |
| Streptothrix | | 1 |
| Nocardia | | 2 |
| Yeast cells and bacilli | 15 | 10 |
| Streptococcus pyogenes hemolyticus | 3 | |
| Streptococcus hemolyticus unidentified | 3 | 2 |
| Streptococcus hemolyticus anginosus | 1 | |
| Streptococcus hemolyticus equinus | 1 | |
| Streptococcus mitis viridans | 11 | 12 |
| Streptococcus salivarius | 1 | 1 |
| Streptococcus fecalis | 2 | 1 |
| Streptococcus viridans unidentified | 5 | 2 |

TABLE II.—EFFECT OF EROSION AND CERVICITIS ON PRESENCE OF PATHOGENIC ORGANISMS IN CERVIX

| Erosion | Yes | No |
|---|---|---|
| Erosion | 141 | 134 |
| Staphylococcus albus | 107 | 91 |
| Staphylococcus aureus | | 1 |
| Staphylococcus citreus | | 1 |
| Staphylococcus hemolyticus | 1 | 1 |
| Micrococcus flavus | 1 | 1 |
| Pneumococcus | 3 | 1 |
| Micrococcus pharyngis siccus | | 1 |
| Micrococcus catarrhalis | 1 | 2 |
| Micrococcus tetragenus | 3 | 3 |
| Large gram negative coccus unidentified | 1 | |
| Diphtheroid bacillus | 15 | 11 |
| Friedlaender's bacillus | 1 | 1 |
| Bacillus lactis aerogenes | 1 | |
| Bacillus proteus | | 2 |
| Bacillus subtilis | 14 | 17 |
| Bacillus xerosis | 1 | |
| Bacillus coli communis | 4 | 4 |
| Bacillus coli communior | 3 | 3 |
| Bacillus pseudodysentericus | 1 | |
| Bacillus fecalis alcaligenes | 2 | |
| Bacillus smegmatis | 5 | |
| Gram positive bacillus unidentified | 1 | 2 |
| Gram negative bacillus unidentified | | 1 |
| Gram positive spore bearing bacillus | 1 | 1 |
| Bacillus mesentericus | | 1 |
| Leptothrix | 16 | 18 |
| Streptothrix | 1 | |
| Nocardia | 1 | 1 |
| Yeast cells and bacilli | 10 | 12 |
| Streptococcus pyogenes hemolyticus | 2 | 2 |
| Streptococcus hemolyticus unidentified | 2 | 2 |
| Streptococcus hemolyticus anginosus | | 1 |
| Streptococcus hemolyticus equinus | 1 | |
| Streptococcus mitis viridans | 10 | 12 |
| Streptococcus salivarius | | 2 |
| Streptococcus fecalis | 1 | 2 |
| Streptococcus viridans unidentified | 5 | 2 |

The cultures were immediately taken to the laboratory where procedures were instituted to isolate and identify the organisms and their various strains. Following is a description of the laboratory technique used in isolating and identifying organisms from these cultures. The laboratory work was performed by two of us (J.W.McM. and G.S.L.). Two swabs were received from each patient. One was cultured aerobically, the other anaerobically. The aerobic cultures were streaked on blood agar and the swabs placed in the depth of sodium glycerophosphate veal broth tubes. This latter procedure was intended to facilitate anaerobic growth in the zones of reduced oxygen tension created around the swabs in the depths of the tubes. The tubes used were from 8 to 10 centimeters in depth. The anaerobic cultures were placed on blood agar and Loeffler's medium and the swab inserted into the depth of litmus milk tubes. Routine transfers to other media were resorted to for specific identification. The anaerobic technique was that of a modified Wright's pyrogallic acid method for approximately one-half the cultures. An anaerobic jar technique was used for the balance.

Aerobic cultures of the cervical secretion were made in each of the 275 patients. Attempts to cultivate organisms anaerobically were made only in the last 167 of the group.

The results obtained are tabulated on Table I. They demonstrate the usual multitude and variety of organisms which may be identified in any body cavity directly continuous with the environment and in which there is no well developed protective mechanism such as a highly bactericidal secretion. In only 37 of these patients were we unable to grow organisms by the usual cultural methods and of these aerobic and anaerobic efforts were made in 23. The 14 remaining were cultured only aerobically.

Our laboratory uses the Holman classification of streptococci. The isolation of these organisms which is usually considered an index of potential pathogenesis was roughly proportional in the aerobic and anaerobic groups, i.e. 275:27::167:18.

Table II demonstrates an effort to determine whether erosion and mild chronic cervicitis constitute a predisposing factor to the occurrence of pathogenic organisms in the cervix or have any influence on their virulence.

From this analysis we must conclude: (1) that such changes in the cervix are not significant in so far as the occurrence of organisms is concerned (141 cases without erosion—215 organisms; 134 cases with erosion—199 organisms); (2) that they exert no influence on the presence of pathogenic organisms since streptococci were present about equally often with and without erosion (21:23, respectively); (3) that they surely do not predispose to postpartum infection since 12 morbid patients had cervical changes prepartum and 16 had normal cervices. In other words, those patients whose cervices were normal in appearance had a morbidity of 12 per cent, in contrast to a morbidity of 8 per cent in the group with erosion and mild chronic cervicitis.

In the light of our figures we believe that prophylactic measures to clear up such conditions of the cervix prepartum for the purpose of preventing intrapartum and postpartum infection are not indicated and may be even undesirable if they constitute a hazard, however slight, of inducing premature labor.

We made an effort to judge from our statistics whether multiparity had any relation to or influence on the occurrence of organisms in the cervix during pregnancy. Our results are tabulated in Table III.

They seem to indicate about an equal occurrence of organisms in pregnant women regardless of parity. There seems to be a somewhat higher incidence of streptococci in the cervices of women during their earlier pregnancies. Results as far as morbidity is concerned are inconclusive because of the difficulty in determining the influence exerted by the greater number of operative procedures and manipulations incident to the delivery of first babies aside from the prepartum presence of cervical organisms. However, it seems fair to assume that the results of cervical trauma due to repeated childbirth do not promote a higher incidence of potentially pathogenic organisms in the pregnant cervix.

A study of the seasonal incidence of various organisms in the cervix is tabulated in Table IV.

An analysis reveals that there is about an equal total number of organisms present throughout the year. However, there is apparently an incidence of streptococci in the fall months (September, October, November) of about 1:6½, increasing in the winter (December, January, February, March) to about 1:5½, and decreasing in the spring and summer (April, May, June, July, August) to 1:10. It was interesting to find an expected increase in the isolation of organisms usually associated with respiratory infections during the months when they are most common.

We divided the patients in this series according to the stage of gestation in weeks as estimated from the approximate date of conception, using the last menstrual flow as our index. The results are tabulated in Table V.

It will be noted that the total number of organisms is proportional to the number of patients cultured at various stages of gestation. There seems to be a higher incidence of streptococci between the eighth and twentieth weeks with a rather definite and sharp drop thereafter. We note this without presuming to place any significance upon it. Errors in deduction are easily made if too many conclusions are drawn from a small series.

In evaluating our morbidity in conjunction with our prepartum cervical cultures, every effort was made to eliminate disturbing factors. All patients were delivered by or under the direct supervision of one of us (E. A. C. or D. L. O'L.). The delivery room routine was identical in each case in so far as vaginal and perineal preparation, etc. were concerned. No attempt has been made to correlate the occurrence of morbidity and the method of delivery, extent of interference, etc. as it is felt that in a series of 275 cases an average will be struck.

We consider our patients morbid if the temperature reaches 100.4 degrees F. on any 2 successive days of the puerperium excluding the first postpartum day. With this standard the morbidity of the entire series was 10.5 per cent—28 patients.

Six of these 28 were morbid from extragenital causes as: purpura hemorrhagica, paronychia, acute bronchitis, lobar pneumonia, artificial pneumothorax for old tuberculosis, postanesthetic pulmonary collapse after cesarean section.

In 11 of the remainder morbid according to the above standard, the pyrexia was of unknown origin, was unsustained, and all were discharged from the hospital by the twelfth postpartum day.

The remainder are summarized as follows: (1) Five mild cases of septic endometritis of the

TABLE III.—EFFECT OF PARITY ON INCIDENCE OF ORGANISMS

| Parity | I | II | III | IV | V | VI | VII | VIII | IX | X | XII | XIII | XV | XXI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | 87 | 70 | 43 | 21 | 18 | 13 | 3 | 5 | 6 | 5 | 1 | 1 | 1 | 1 |
| Staphylococcus albus | 65 | 44 | 34 | 15 | 10 | 12 | 2 | 3 | 4 | 5 | | | | |
| Staphylococcus aureus | 1 | | | | | | | | | | | | | |
| Staphylococcus citreus | | | 1 | | | | | | | | | | | |
| Staphylococcus hemolyticus | 2 | | | | | | | | | | | | | |
| Micrococcus flavus | 1 | 1 | | | | | | | | | | | | |
| Pneumococcus | 1 | 1 | | 1 | 1 | | | | | | | | | |
| Micrococcus pharyngis siccus | 1 | | | | | | | | | | | | | |
| Micrococcus catarrhalis | 1 | | | 1 | | | | | 1 | | | | | |
| Micrococcus tetragenus | 1 | 4 | | 1 | | | | | | | | | | |
| Large gram negative coccus unidentified | 1 | | | | | | | | | | | | | |
| Diphtheroid bacillus | 10 | 5 | 5 | 1 | | 2 | | | 1 | 1 | 1 | | | |
| Friedlaender's bacillus | 1 | | | 1 | | | | | | | | | | |
| Bacillus lactis aerogenes | | 1 | | | | | | | | | | | | |
| Bacillus proteus | 1 | | | 1 | | | | | | | | | | |
| Bacillus subtilis | 9 | 11 | 3 | 2 | 1 | 2 | | 1 | | | 1 | | | |
| Bacillus xerosis | 1 | | | | | | | | | | | | | |
| Bacillus coli communis | 1 | 2 | 2 | | 1 | | | 1 | | | | | | |
| Bacillus coli communior | 1 | 2 | 2 | 1 | | 1 | | | | | | | | |
| Bacillus pseudodysentericus | | 1 | | | | | | | | | | | | |
| Bacillus fecalis alcaligenes | 2 | | | | | | | | | | | | | |
| Bacillus smegmatis | 1 | 3 | | 1 | | | | | | | | | | |
| Gram positive bacillus unidentified | 1 | | | | 2 | | | | | | | | | |
| Gram negative bacillus unidentified | 1 | | | | | | | | | | | | | |
| Gram positive spore bearing bacillus | 1 | 1 | | | | | | | | | | | | |
| Bacillus mesentericus. | | | | | 1 | | | | | | | | | |
| Leptothrix | 11 | 9 | 4 | 2 | 2 | 3 | | 1 | 1 | | 1 | | | |
| Streptothrix | | 1 | | | | | | | | | | | | |
| Nocardia | | | | | 1 | | | 1 | | | | | | |
| Yeast cells and bacilli | 3 | 9 | 4 | 1 | 2 | | | | | | | 1 | 1 | |
| Streptococcus pyogenes hemolyticus | 3 | | | | | | | | | | | | | |
| Streptococcus hemolyticus unidentified | 2 | 1 | 1 | | | | | | | 1 | | | | |
| Streptococcus hemolyticus anginosus | 1 | | | | | | | | | | | | | |
| Streptococcus hemolyticus equinus | | | 1 | | | | | | | | | | | |
| Streptococcus mitis viridans | 6 | 2 | 6 | 1 | 1 | 2 | 1 | 2 | | | | | | |
| Streptococcus salivarius | 1 | | 1 | | | | | | | | | | | |
| Streptococcus fecalis | | 1 | 2 | | | | | | | | | | | |
| Streptococcus viridans unidentified | 3 | | 2 | | 1 | 1 | | | | | | | | |

type that in the old literature would probably be called a sapremia. These patients recovered quickly and were all discharged from the hospital before the sixteenth postpartum day. (2) Three cases of infected perineal wounds, 2 of which resulted from third degree extension of median episiotomies. These patients likewise were discharged by the end of the second week. (3) Two patients with acute pyelitis who had been in the hospital prepartum 2 days and 35 days and were

TABLE IV.—SEASONAL VARIATION IN THE INCIDENCE

| | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Staphylococcus albus | 21 | 17 | 21 | 14 | 8 | 12 | 11 | 8 | 14 | 14 | 19 | 31 |
| Staphylococcus aureus | | | 1 | | | | | | | | | |
| Staphylococcus citreus | | | | | | 1 | | | | | | |
| Hemolytic staphylococcus | | | 2 | | | | | | | | | |
| Micrococcus flavus | | | | | | | 1 | | | 1 | | |
| Pneumococcus | 1 | 2 | | | | 1 | | | | | | |
| Micrococcus pharyngis siccus | | | 1 | | | | | | | | | |
| Micrococcus catarrhalis | | 1 | | 1 | | | | | | | | 1 |
| Micrococcus tetragenus | | 1 | | | | | 1 | 3 | | | | 1 |
| Large gram negative coccus unidentified | | 1 | | | | | | | | | | |
| Diphtheroid bacillus | 5 | 5 | 1 | 1 | 1 | | 2 | 2 | 1 | 1 | 1 | 5 |
| Friedlaender's bacillus | | | | | | | | | 1 | 1 | | |
| Bacillus lactis aerogenes | | 1 | | | | | | | | | | |
| Bacillus proteus | | | | | | | | 1 | | | | 1 |
| Bacillus subtilis | 6 | 4 | 6 | 3 | 1 | 1 | 1 | | 2 | 3 | 2 | |
| Bacillus xerosis | 1 | | | | | | | | | | | |
| Bacillus coli communis | 1 | 2 | | 1 | 1 | | 2 | | | | 1 | |
| Bacillus coli communior | | | | 1 | 1 | 1 | 1 | 1 | | | | |
| Bacillus pseudodysentericus | | | | | | | | | | | | 1 |
| Bacillus fecalis alcaligenes | | | | | | 2 | | | | | | |
| Bacillus smegmatis | | | | | | | | 1 | 2 | | 1 | |
| Gram positive bacillus unidentified | | 1 | | | 1 | | | | | | | |
| Gram negative bacillus unidentified | 1 | 1 | | | | | | | | | | |
| Gram positive spore-bearing bacillus | | | | | | | | | 1 | | | 1 |
| Bacillus mesentericus | | 1 | | | | | 1 | | | | | |
| Leptothrix | 5 | 4 | 3 | 2 | | 2 | 1 | | 2 | 4 | 1 | 4 |
| Streptothrix | 1 | | | | | 1 | | | | | | |
| Nocardia | | | | | | | | | | 1 | 1 | |
| Yeast cells and bacilli | 6 | 3 | 4 | 1 | | | | | | | 3 | 4 |
| Streptococcus pyogenes hemolyticus | 1 | | | | | | | | | | 1 | 1 |
| Streptococcus hemolyticus unidentified | | | 3 | | | | | | | | | 1 |
| Streptococcus hemolyticus anginosus | | | | | | | | | | | 1 | |
| Streptococcus hemolyticus equinosus | | | | | | | | | | | 1 | |
| Streptococcus mitis viridans | 2 | | 3 | | | 1 | 3 | 1 | 2 | 3 | 1 | 3 |
| Streptococcus salivarius | | 1 | | | | | | | | | | 1 |
| Streptococcus fecalis | | | | | 1 | | | 1 | | | | |
| Streptococcus viridans unidentified | 1 | 3 | 1 | | | | | | | 1 | | 1 |
| Number of patients per month | 34 | 29 | 31 | 19 | 12 | 14 | 13 | 12 | 17 | 21 | 25 | 35 |

discharged 21 and 15 days postpartum, respectively. (4) One patient with femoral phlebitis with convalescence prolonged 12 days.

There was 1 maternal mortality in the group resulting from postpartum hemorrhage following delivery for placenta previa. This patient had been packed and transfused but succumbed from shock 15 hours after delivery.

Of the 22 patients morbid because of genital tract infection, 7, or 31.5 per cent, had positive

TABLE V.—PERIOD OF GESTATION IN WEEKS

| | 4–7 | 8–11 | 12–15 | 16–19 | 20–23 | 24–27 | 28–31 | 32–35 | 36–39 |
|---|---|---|---|---|---|---|---|---|---|
| Staphylococcus albus | 5 | 21 | 29 | 23 | 32 | 31 | 31 | 19 | 5 |
| Staphylococcus aureus | | | 1 | | | | | | |
| Staphylococcus citreus | | | | | | | | | 1 |
| Hemolytic staphylococcus | | 1 | | 1 | | | | | |
| Micrococcus flavus | | | | | 2 | | | | |
| Pneumococcus | | | | 1 | 2 | 1 | | | |
| Micrococcus pharyngis siccus | | | | | 1 | | | | |
| Micrococcus catarrhalis | | | 1 | 1 | | 1 | | | |
| Micrococcus tetragenus | | | 1 | 1 | 2 | 1 | | | 1 |
| Large gram negative coccus unidentified | | | | | 1 | | | | |
| Diphtheroid bacillus | | 5 | 3 | 4 | 6 | 3 | 3 | 2 | |
| Friedlaender's bacillus | | | | | | | 2 | | |
| Bacillus lactis aerogenes | | | 1 | | | | | | |
| Bacillus proteus | | 1 | | 1 | | | | | |
| Bacillus subtilis | | 5 | 5 | 3 | 2 | 7 | 5 | 1 | 1 |
| Bacillus xerosis | | 2 | | | | | | | |
| Bacillus coli communis | 1 | | 1 | | | 3 | 2 | | 1 |
| Bacillus coli communior | | | | | 2 | | 2 | 1 | |
| Bacillus pseudodysentericus | | | | 1 | | | | | |
| Bacillus fecalis alcaligenes | | | | | 1 | 1 | | | |
| Bacillus smegmatis | 1 | | 1 | | 3 | | 1 | | |
| Gram positive bacillus unidentified | | | | | 1 | | 1 | | |
| Gram negative bacillus unidentified | | | 1 | | | 1 | | | |
| Gram positive spore-bearing bacillus | | | 2 | | | | | | |
| Bacillus mesentericus | | | | | | 1 | | | |
| Leptothrix | | 4 | 7 | 4 | 1 | 7 | 9 | 1 | |
| Streptothrix | | | | | | | | 1 | |
| Nocardia | | | | | | | 2 | | |
| Yeast cells and bacilli | | 1 | | 3 | 2 | 5 | 5 | 5 | 1 |
| Streptococcus pyogenes hemolyticus | | | 1 | 1 | 1 | | | | |
| Streptococcus hemolyticus unidentified | | 1 | 2 | 1 | | | | 1 | 1 |
| Streptococcus hemolyticus anginosus | | | | 1 | | | | | |
| Streptococcus hemolyticus equinus | | 1 | | | | | | | |
| Streptococcus mitis viridans | | 3 | 5 | 4 | 1 | 3 | 3 | 1 | |
| Streptococcus salivarius | | | | 1 | | | 1 | | |
| Streptococcus fecalis | | | | | | | 3 | | |
| Streptococcus viridans unidentified | | 2 | 1 | 1 | 2 | 1 | | | |
| Number of patients | 5 | 27 | 38 | 40 | 43 | 40 | 43 | 28 | 8 |

streptococci cultures from the cervix prepartum. Three were hemolytic, 2 definitely Streptococcus pyogenes hemolyticus. From an additional patient with a negative prepartum culture a pyogenic streptococcus was obtained from the lochia, apparently proving definitely an exogenous infection.

Table VI presents the figures from the entire series with the object of discerning a relationship between the prepartum presence of nonhemolytic

and hemolytic streptococci and the occurrence of postpartum morbidity.

TABLE VI.—RELATIONSHIP BETWEEN PREPARTUM STREPTOCOCCI AND POSTPARTUM MORBIDITY IN 275 PATIENTS

| | Morbidity | |
|---|---|---|
| | No. | Per cent |
| Total number of cases—275 | 29 | 10.5 |
| Excluding extragenital causes | 22 | 8 |
| Excluding extragenital causes and positive streptococcus cultures | 15 | 5.4 |
| 40 cases with positive streptococcus cultures | 7 | 17.5 |
| 31 cases with nonhemolytic streptococci | 4 | 12.9 |
| 9 cases with hemolytic streptococci | 3 | 33.3 |

It will be noted in the above that in 40 of the 275 patients, or 14.5 per cent, streptococci were isolated from the cervix. Nine of these were hemolytic streptococci, 3.3 per cent.

## SUMMARY AND CONCLUSIONS

1. A multitude of various micro-organisms were cultured from the cervix during pregnancy.

2. Streptococci were obtained in cultures from 14.5 per cent, and in 3.3 per cent were hemolytic.

3. Erosion and mild chronic nonspecific cervicitis are not contributing factors to puerperal morbidity.

4. Cervical trauma incident to repeated childbearing does not promote a higher incidence of potentially pathogenic organisms in the cervix.

5. The incidence of streptococci as well as the number of micro-organisms of the respiratory group increase during the months when respiratory infections are more common.

6. There seemed to be a definite but perhaps not significant decrease in the incidence of positive streptococcal cervical cultures after the twentieth week of gestation.

7. Morbidity is somewhat higher in cases in which the cervices harbor streptococci, especially if these organisms promote hemolysis.

8. Endogenous infection from the cervix does occur but in the present series has been exceedingly mild and of short duration.

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# DACRYOCYSTORHINOSTOMY

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DACRYOCYSTORHINOSTOMY is not a new procedure; its use has been reported periodically since the time of Platner (10, 1724). The operation is not easy but, once mastered, it gives such a satisfactory re-establishment of the normal physiology that, in the great majority of cases of obstruction of the nasolacrimal duct, there can be little excuse for removal of the lacrimal sac. The patient and surgeon should be content with nothing less than this desirable result. A definite classification of the results based on certain tests is proposed.

Many different methods have been used approaching through a skin incision or intranasally, or even through the antrum.

Ohm in 1920 made an important contribution, operating through an external incision. Instead of removing the sac wall or nasal mucous membrane, he fashioned anterior and posterior flaps from them and attached them to each other by means of sutures. In 1921 Dupuy Dutemps described a similar procedure. This operation we will describe later in greater detail; it has proved itself a worthy procedure. Direct continuity was thus established by surgically joining the nasal mucous membrane to wall of the lacrimal sac.

In 1938 one of us (L. G.) described what he termed "simple dacryocystorhinostomy" which very closely resembled the technique originally described by Montaigne in 1836. The results were not permanently satisfactory in sufficient cases to warrant continuation of this method.

We felt that the method of making the flaps was relatively unimportant. In our series, and in the cases reported in the literature, the results were uniformly superior when the flaps were definitely sewn in position to form a continuous mucous membrane bridge for new bony canal.

## INDICATIONS

1. The operation is indicated when there is obstruction of the lacrimal drainage apparatus at the lower portion of the lacrimal sac or nasolacrimal duct in the absence of acute inflammatory reaction. The presence of a chronic infection in the sac does not contraindicate the operation unless the infection is tuberculous. Even the presence of a tense mucocele is not an absolute contraindication. If the sac can be entered easily with a blunt cannula or probe there is probably not a cicatricial obstruction of the canaliculi.

2. In the presence of trauma when part of the lacrimal sac remains and the canaliculi are intact.

3. When after a partial removal of the lacrimal sac a moderate amount of discharge persists.

4. After a dacryocystectomy, a repair may be done according to the technique of Arruga by implantation of the end of the canaliculus, which has been dissected free, into the nasal mucous membrane.

As a preliminary to intra-ocular operations, the reestablishment of the flow of the lacrimal secretion through the conjunctival sac into the nose is preferable to dacryocystectomy because it results in a cleaner eye with fewer organisms than are found with the stagnation that must follow extirpation. This was proved by the work of Mattice reported in 1931. He found pneumococci in 43 per cent of conjunctival sacs after extirpation, while Bumke and West (9) found that pathological organisms disappeared from the conjunctiva soon after re-establishment of drainage through the sac.

## CONTRAINDICATIONS

1. The operation is contraindicated when there is irremediable obstruction to the puncta or canaliculi in any part, especially at the entrance to the sac.

2. When malignant disease involves the sac.

3. When the mucous membrane lining the sac has been destroyed by an incurable condition, such as tuberculosis, actinomycosis, or malignancy.

4. When there is present extensive nasal disease with obstruction in the region of the anterior end of the middle turbinate where the new opening is to be made, or sinusitis is present with emphasis on the ethmoids. When polypi, obstructions in this region, or sinusitis are eliminated, the procedure may be carried out.

5. When acute inflammation is present. When this subsides the operation may be done. Chronic infection of the sac is not a contraindication.

## TECHNIQUE

1. *Preparation.* Infection in the lacrimal sac is treated. If any acute inflammation is present, the

From the Research Department of the New York Eye and Ear Infirmary.

TABLE I.—COMPARATIVE RESULTS WITH AND WITHOUT SUTURES, BY ALL METHODS AND ALL OPERATORS

Dacryocystorhinostomy

| Test | | Successes | | Failures | |
|---|---|---|---|---|---|
| | | Cases | Per cent | Cases | Per cent |
| Mercurochrome (gravitating into nose without force in 2 to 20 minutes) | Sutures | 12 | 21.4 | 3 | 5.4 |
| | No sutures | 6 | 10.7 | 34 | 60.7 |
| (Gross or seen intranasally) | Dams | 1 | 1.8 | 0 | |
| Total | | 19 | 33.9 | 37 | 66.1 |
| Total successes and failures | | | | | 56 |
| Mercurochrome plus irrigation | Sutures | 17 | 22.3 | 4 | 5.3 |
| | No sutures | 13 | 17.1 | 38 | 50.0 |
| | Dams | 3 | 4.0 | 1 | 1.3 |
| Total | | 33 | 43.4 | 43 | 56.6 |
| Total successes and failures | | | | | 76 |
| Totals based on patients' statement that there is no pus but slight or some epiphora | | 50 | 53.7 | 43 known | 46.3 |
| Total successes and failures | | | | | 93 |

TABLE II.—GENERAL SURVEY OF DATA IN CASES OF LACRIMAL SAC DISEASE REGARDING AGE AND SEX

General

| Sex | Average ages* | Number of cases | Per cent of cases |
|---|---|---|---|
| Males | 47.03 | 83 | 24 |
| Females | 44.50 | 264 | 76 |
| Total cases | 45.70 | 347 | 100 |

*Youngest, 4 weeks; oldest, 80 years.

Dacryocystorhinostomies

| Sex | Average ages* | Number of cases | Per cent of cases |
|---|---|---|---|
| Males | 55.40 | 27 | 25 |
| Females | 41.60 | 82 | 75 |
| Total cases | 48.50 | 109 | 30.4 |

*Youngest, 4 years; oldest, 75 years.

Extirpations

| Sex | Average ages* | Number of cases | Per cent of cases |
|---|---|---|---|
| Males | 47.50 | 33 | 24 |
| Females | 48.02 | 105 | 76 |
| Total cases | 47.76 | 138 | 39.0 |

*Youngest, 4 years; oldest, 78 years.

Nonsurgical

| Sex | Average ages* | Number of cases | Per cent of cases |
|---|---|---|---|
| Males | 38.20 | 19 | 17 |
| Females | 43.90 | 93 | 83 |
| Total cases | 41.05 | 112 | 30.6 |

*Youngest, 4 weeks; oldest, 80 years.

contents of the sac may usually be gently aspirated through either upper or lower canaliculus and the sac carefully washed out. Subsequently mercurochrome and hot compresses are used. When the inflammation has subsided the first form of dacryocystorhinostomy, i.e. probing, may be attempted. This can usually be done almost painlessly if the anesthetic (2 per cent pontocaine or 4 per cent cocaine) with ephedrine, with which the sac is filled at 10 minute intervals, is allowed to remain in the sac a sufficient length of time—at least 20 minutes. Hypodermic injection of 2 or 3 drops of 4 per cent novocain into the nasal duct is occasionally necessary for complete anesthesia. If drainage is not reestablished by two or three probings, further attempts are usually futile. We have had little experience with retained probes or cannulas.

When the reestablishment of drainage through the normal duct becomes impossible, a new opening, properly constructed, serves the purpose very well. The preliminary probing and treatment serve to reduce the severity of the pyogenic infection in the sac in preparation for the operation. It may be carried out, however, in the presence of a chronic pustular condition without danger of complicating infection, if the sac is aspirated and washed out at the time of operation.

The nose should be checked over first to see that there is no gross obstruction or infection present.

*2. Lighting.* Besides general illumination of the operative field, a good headlight, arranged so the vision is along the axis of the illuminating beam, is essential.

*3. Anesthesia. a.* Local. The corresponding naris is sprayed with 4 per cent cocaine solution and the upper part packed with a cocaine-soaked pledget in the region superior and anterior to the middle turbinate. The skin is injected with 4 per cent novocain to which is added 2 drops of 1:1000 solution of epinephrine hydrochloride for each 5 cubic centimeters. A No. 27, half inch needle is employed. Next, with a longer needle, 1.5 cubic centimeters of the same solution is injected well behind the dome along the nasal wall of the orbit directly against the periosteum. In a similar manner an injection is made behind the lower portion of the sac, and finally the needle is directed into the entrance to the nasolacrimal duct

and 0.5 of a cubic centimeter is injected. One can easily enter the bony canal by palpating the anterior lacrimal crest on the opposite side and by directing the needle from above to a symmetrical location on the involved side.

*b.* General. Preliminary sedation with 4.5 to 6 grains of nembutal for the average adult is given by mouth 15 minutes before operation. If a general anesthetic is employed, a postnasal plug is used.

*4. Operative procedure.* A 15 millimeter arcuate skin incision is made, starting 3 millimeters nasal to and 4 millimeters above the medial canthus. This is carried down to the periosteum. A speculum is then placed to keep the wound open. The medial canthus is straddled with a Lester forceps, and its medial attachment is severed completely at the point where it spreads out after passing over the upper portion of the sac to be attached to the periosteum nasally. The dome usually extends above the upper portion of the ligament although occasionally it does not. The superficial layer of the deep or tarso-orbital fascia is incised along its attachment to the anterior lacrimal crest, hugging the bone tightly to avoid injury to the sac. This anterior lacrimal crest which can be readily felt by palpation is the outstanding landmark; the sac is always to be located directly behind this bony ridge. If there is any doubt as to the presence or integrity of the walls or the location of the sac, as in traumatism with fracture cases, or if previous surgery has been attempted, it is well to aspirate the contents of the sac and inject *very gently* 2 or 3 drops of methylene blue in order to identify its wall later. This latter procedure should not be done directly after probing.

The sac, which is easily identified by its bluish color, is pushed temporally and an opening is made in the bone starting along the anterior crest. The opening can be made with chisel and hammer which can be supplemented, if desired, by a 4 millimeter hand bone trephine. The rapidly revolving automatic electric trephines are not as safe or satisfactory. Soft tissues may become wrapped around the revolving end and serious damage result before the machine can be stopped. Another danger from the electric trephine is damage to the nasal mucous membrane, which is rarely injured when the hand chisel and mallet are used. When the opening is sufficiently large to admit a small size bone-cutting forceps of the Citelli or Kerison type, this instrument is used to clip off the margins to enlarge the opening to about 1.5 centimeters in diameter. A sharp mastoid curette is sometimes useful for this purpose. In making the bony opening, an ethmoid cell may be encountered. This can be determined by inability to see into the nasal cavity and thinness of the mucous membrane lining it. When the thick nasal mucous membrane is identified and the bony opening is sufficiently wide, all the bony chips are removed and the edges of the opening smoothed off. In making the osseous window, one usually encounters the anterior end of the middle turbinate, and the opening in the mucous membrane is planned either superior and anterior to this structure or inferior to it.

The incision in the nasal mucous membrane is then made in the shape of an H with a long horizontal bar so planned that the two flaps outlined by the upper and lower halves of the H will join corresponding flaps from the sac. The posterior flaps are united by two plain catgut No. 000 sutures. These are not easily applied in some cases, but small Yankauer needles, if well sharpened, are of help. Occasionally the posterior flaps cannot be united. This is not of much importance if the anterior flaps are brought together. The wound is closed with interrupted black silk sutures, one suture passing through the medial canthal ligament as well as the skin. At the end of the operation, the cornea should be inspected for traumatism by instillation of a drop of fluorescin and the conjunctival sac should be flushed to remove any infectious material. A pressure dressing is applied, particular attention being paid to the proper alinement of the lashes. It may be changed in 24 hours in order to allow inspection of the cornea but is reapplied and left in position for a week, after which time a light dressing may be used for another week or so. There is practically no postoperative reaction.

### COMPLICATIONS IN THE OPERATIVE TECHNIQUE

*1. Hemorrhage.* This usually complicates the operation in four stages and may be checked in the following ways: (a) Just after making the skin incision, hemorrhage is often controllable by changing the position of the prongs of the speculum or by small hemostatic forceps, compressing the vessels or bleeding points. (b) While making the window in the bone, it is sometimes controllable by pressure or packing with adrenalin-soaked gauze. Actual cautery or diathermy coagulation current may be necessary. The hemorrhage at this stage is most annoying and interferes with the dissection. A small suction tube can be used to great advantage in keeping the field clean. A slightly bent plain-tipped eyedropper makes a good tip for this purpose. (c) Occasionally when the nasal mucous membrane is incised, hemorrhage occurs. It is usually fairly

COMPARISON OF DACRYOCYSTECTOMY WITH DACRYOCYSTORHINOSTOMY

| | Dacryocystectomy | Dacryocystorhinostomy |
|---|---|---|
| 1. | Eliminates pustular discharge and infection | Same |
| 2. | Does not eliminate overflow of tears | Eliminates overflow of tears |
| 3. | Does not reestablish the normal drainage of the impurities and secretions of the conjunctival sac | Reestablishes the normal drainage |
| 4. | Very difficult to reestablish drainage if the sac is completely removed | May be repeated with hope of success in the occasional case where the drainage opening closes |
| 5. | Operation is final | Dacryocystectomy may still be done if necessary |
| 6. | Patient usually complains about the remaining tearing and is not completely satisfied | Patient is usually completely satisfied |
| 7. | Dacryo-adenectomy or other procedure is often required to reduce the tearing | Other operations are rarely necessary |
| 8. | Simpler operation | Considerably more difficult operation |
| 9. | No air regurgitation possible | Cases have been reported in which air is forced back through the canaliculus on blowing the nose. This was not seen in any case of our series but undoubtedly it may occur |

COMPARISON OF INTRANASAL PROCEDURE WITH EXTERNAL OPERATION

| | Intranasal operation | External operation |
|---|---|---|
| 1. | Limited operating field | Better exposure of operating field |
| 2. | Frequently requires preliminary removal of a deviated septum and almost always removal of the anterior tip of the middle concha | Rarely requires any intranasal surgery except in cases of gross pathology or complete obstruction |
| 3. | Intranasal granulations must frequently be treated after operation | No traumatism to the intranasal structures |
| 4. | Postoperative scarring of the nasal mucous membrane with its resultant formation of dried secretion and scabs at the site of the scar | No damage or alterations of nasal mucous membrane |
| 5. | Operation in the field of the rhinologist | Operation in the field of the ophthalmologist who almost always sees these patients first and who can also relieve other pathological condition of the lacrimal apparatus when necessary |

easily controlled by packing the wound although rarely the packing may need to be done from the nose as well. (d) Late hemorrhage occurring a few hours after the operation is rare and has not been seen by any of us. Packing of the nose is indicated with, possibly, cauterization of the bleeding point.

2. *Dissection.* One should hardly need to mention failure to locate the sac. This failure is most easily avoided by first locating and completely severing the attachment of the medial canthal ligament nasally and by palpation of the anterior lacrimal crest with the finger. This is always palpable and the sac is always located just posterior to this bony crest.

3. *Injury to the sac during dissection.* This is most easily avoided by cutting through the tarso-orbital fascia directly at its attachment to the periosteum along the anterior lacrimal crest. If the sac is incised, it is usually not serious as the incision can generally be extended to form the flaps. If more extensive damage is done, enough sac wall can be salvaged to unite at least one lip of the nasal mucous membrane. In fact, the incision in the nasal mucous membrane may be changed to provide one longer flap if necessary. One well formed flap united to one sac edge will provide a permanent drainage tract into the nose.

4. *Disease of the nasal mucous membrane.* This is occasionally present, making handling difficult. This complication can be avoided often by preoperative treatment of the nose and sinuses. The nasal mucous membrane may be quite fragile making it impossible to form proper flaps to unite to the sac. In this case the sac should be dissected free and cut off at the lower part. A suture should be passed through the margin of the lower cut edge of the sac, through the bony opening, and brought out through the nostril; the lower end of the sac should be pulled into the nose and the suture anchored to the cheek, as originally done by Forsmark in 1911.

5. *Failure of the newly created duct to function.* This may be due to (a) injury to the canaliculus at the time of the operation, or (b) closure of the osseous opening on account of (1) insufficient size or improper placement of the fenestra in the first place, or (2) lack of proper apposition of the nasal mucous membrane and the lacrimal sac flaps. In this case a probing through the new opening may be attempted and, if this is unsuccessful, the entire operation may be repeated with good prospect of success.

6. *Postoperative complication.* A case in which a corneal ulcer developed before the first dressing on the third day, resulting in some corneal opacity, has been observed. This was probably due to in-

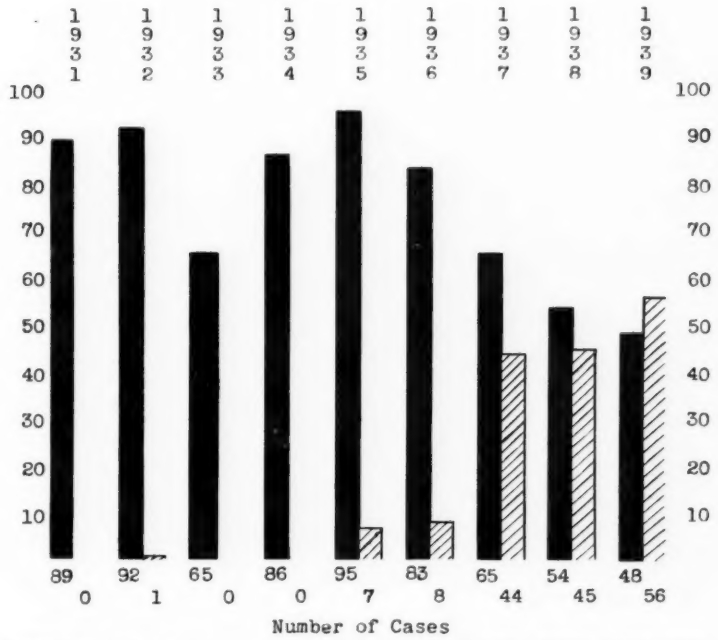


TABLE III.—Tear sac operations at New York Eye and Ear Infirmary. Black areas, dacryocystectomies; cross hatched areas, dacryocystorhinostomies.

complete cleansing of purulent discharge from the conjunctival sac before the dressing was applied. The pressure dressing may have been applied too tightly or the lashes may have been inverted against the cornea by the dressing.

### CRITERIA USED TO JUDGE SUCCESS OF THE OPERATION

Most surgeons in reporting their cases, especially those reporting nearly one hundred per cent successful operations, fail to mention what criteria were used. It is felt that some standard should be set up for this purpose.

1. *Clinical relief of symptoms:* (a) the absence of tearing should be specifically stated whether or not it is absent at all times and especially in the cold and the wind. The result can not be judged as "completely successful" unless there be no more tearing of the affected eye than there is in the other eye, if the other lacrimal drainage apparatus is normal. (b) The absence of discharge is a distinct advantage to be gained but is also obtained by a well performed dacryocystectomy.

2. *Physiological instillation test.* (a) The most severe test is the instillation at a 3 minute interval of two drops of mercurochrome or other dye into the conjunctival sac and ascertaining its presence in the nasal cavity by blowing the nose 10 to 20 minutes later. The stain will normally appear on the handkerchief. (b) It may be necessary for a time to instill 2 drops of vasoconstrictor to reduce the congestion of the mucous membrane lining the lacrimal passage before the dye will pass into the nose spontaneously. This method of treatment will frequently result in a healthier mucous membrane and establishment of spontaneous drainage. Unless spontaneous drainage without the use of vasoconstrictor be established, the case can not be classified as "completely successful."

3. *Irrigation test.* Saline will pass into the nose by irrigation, administered by means of a curved lacrimal cannula or a glass syringe inserted into the punctum, provided there is no dense stricture. This does not mean that spontaneous drainage of the tears has been established.

4. *Irrigation after probing.* Probing of the new passage is relatively easy and will be necessary if the new opening closes. The probe is passed through the new bony ostium. Permanent drainage may sometimes be established in this manner

if the opening has been closed only by means of mucous membrane. However, if the bony opening closes by means of dense scar tissue or a new growth of bone, the entire procedure must be repeated. In rare instances dacryocystectomy must eventually be performed, although in our series this was not done in any case.

CLASSIFICATION OF RESULTS BASED ON THE ABOVE CRITERIA

1. (*a*) *Complete success.* Both clinical relief and proof of the reestablishment of normal physiology (by instillation test).

(*b*) *Partial success.* Relief from the excessive discharge with continuation of any tearing. These cases may become "completely successful" after treatment.

2. (*a*) *Complete success.*

(*b*) *Partial success.* Slight tearing in wind or some tearing with absence of discharge.

3. *Partial success.* Same as 1 (b).

4. *Complete failure.* No relief of tearing or discharge.

At the New York Eye and Ear Infirmary, dacryocystorhinostomy was practically unknown before 1931. Since 1934 the number of dacryocystorhinostomies has rapidly increased and dacryocystectomies decreased until today the number of the former being performed surpasses the latter (see Table III). This is a healthy trend and more and more patients with an atresia of the lacrimal duct are demanding the advantages of this former operation with its relief of all signs and symptoms rather than simply relief from the infectious process present in the lacrimal sac. It has often been asserted that the surgeon is content with the results of dacryocystectomy. To this may be added that the patient is rarely completely satisfied.

In a study of all the cases of dacryocystorhinostomy done at the New York Eye and Ear Infirmary by various operators, the highest percentage of successful cases was obtained when the nasal mucous membrane and lacrimal sac flaps were united by suture. These statistics are also borne out by a review of the cases reported in the literature.

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# ATRAUMATIC AMPUTATION THROUGH THE LOWER THIGH (CALLANDER)

## Modified Technique

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IN 1935, Dr. C. L. Callander became strongly impressed with the severe shock and high mortality of lower thigh amputation performed according to the usual technique which transects the large thigh muscles through their fleshy portions. His results were especially unsatisfactory in those cases in which there was infection with anaerobic gas-producing bacteria, and he believed that the opening of large muscle spaces was an important factor contributing to the spread of infection up the stump. In an effort to avoid the high mortality of the usual muscle-cutting thigh amputation, Callander devised a technique which represented a great advance in the surgery of amputations. In this new technique no muscle bellies were cut; all sections of muscles were made through their tendinous insertions. The skin flaps were made very loose. The patella was excised and its bed made available as a cover for the bone end. As the skin flaps retracted snugly about the bone, the hamstrings pulled the suture line posteriorly and proximally and drew the patellar bed over the end of the stump. For further details the reader is asked to consult the original articles (1, 2).

In commenting on the anatomical basis for his operation, Callander presents certain pertinent facts: (1) The popliteal fossa is in reality a closed cavity, the intact upper limit of which acts as an effective barrier to the spread of infection up the thigh. This bulwark is preserved if muscles are cut only through their tendinous portions but is destroyed in the operation which cuts the fleshy portions. (2) The deep femoral artery nourishes the tissues of the thigh, and the skin and subcutaneous tissues of the knee and upper leg. It is rarely affected by occlusive arterial disease even when the femoral artery and its continuation, the popliteal, are completely blocked by the process. This allows the fashioning of long viable flaps from the skin and subcutaneous tissues of the upper leg in the majority of cases of advanced occlusive arterial disease. These considerations are especially important in amputation for vascular disease, when the control of the spread of infection and the complete absence of tension are cardinal requisites for a successful outcome.

The following additional considerations recommend the operation for peripheral vascular disease: (1) The omission of the tourniquet eliminates possible further injury to an embarrassed peripheral circulation. (2) The absence of shock is noteworthy. (3) The ability to sit up in a chair within 1 to 3 days is a great preventative against stasis in the general and pulmonary circuits in old and debilitated patients. (4) The control of the circulation of the extremity is effected early, thus curtailing the return of contaminated blood and reducing the amount of arterial bleeding. (5) The stump is long, mobile from the first, practically painless, bears the body weight well on its end, and is easily fitted with a satisfactory prosthesis.

Because of these favorable points, the new type of amputation was employed by the Mt. Zion clinic of sympathetic and vascular surgery for the first time in 1936. The results were so gratifying that it was soon adopted as the routine lower thigh amputation in the clinic. Our experiences with the Callander type of amputation are being reported in detail in another article. It is sufficient here to remark that the results were far more satisfactory than those in which the orthodox technique was employed.

Despite the low mortality, certain points in the course of the new amputation required further study. The percentage of delayed healing was considerable; edema of the stump, even in cases which healed per primam was frequent and persistent; and the patellar bed sometimes formed a mobile mass which did not fit snugly over the bone and interfered with the satisfactory use of the prosthesis.

In those cases in which necrosis of the deeper tissues occurred the patellar recess appeared to be the area most often and most profoundly affected by the process. This may have been due to the fact that the peripatellar tissues are, as a rule, poorly vascularized, especially in patients suffering from arterial insufficiency. This area, too, is

From the Clinic of Sympathetic and Vascular Surgery, service of Dr. Harold Brunn, Mt. Zion Hospital, San Francisco, California.

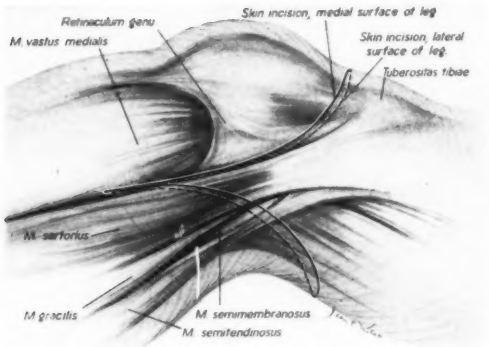


Fig. 1. Flaps of skin and subcutaneous tissue are marked out as shown. Note that flaps are of approximately equal length and that only about 1 centimeter of the proximal end is common to both flaps.

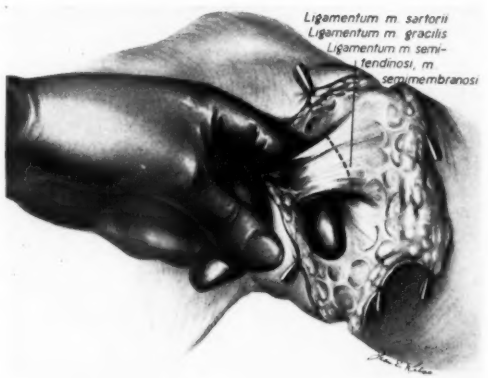


Fig. 2. Section of medial hamstring tendons. The flaps have been marked out and dissected so as to expose the tendons of the hamstring muscles at their insertions. The finger is slipped under the hamstring tendons preparatory to section.

of necessity subjected to considerable trauma in separating the patella from the intimately attached peripatellar tissues. The retention of the peripatellar tissues to form a cushion for the bone end was stressed in the operation as described by Callander. In the older muscle transecting type of technique, even though fascia and muscle were used to cover the bone, these structures soon atrophied, thus leaving the bone end covered only by skin and a small amount of subcutaneous tissue. Despite this, satisfactory end-bearing was achieved. The necessity, and even the advisability, therefore, of retaining the patellar bed is open to question. These apparent disadvantages in no way detract from the soundness of the basic principles underlying the Callander technique. They act rather as a challenge to modify and, if possible, improve the desirable operation of low thigh amputation which transects tendons only.

The author offers herein a modified technique which has been developed in an effort to eliminate some of the disadvantages noted above. In short, the modification consists in (1) a change in the outline of the skin flaps, (2) removal of the patella and the peripatellar tissues, and (3) higher bone section through the medullary portion of the femur. It has been used on 14 cases with 1 death resulting from cardiac failure in a man of 73 years. These modified amputations, as well as other earlier amputations by use of the original Callander technique, have been performed by the author on patients suffering from affections of the peripheral arteries. The results of the modified amputation appear to offer advantages over the original technique in (1) the tendency to heal *per primam*, in (2) the contour of the stump, and in (3) the ability to use prosthesis. The steps in the operation follow.

## OPERATIVE PROCEDURE

*Preparation of the field.* A sterile dressing is applied to the foot and the lower half of the leg and bandaged firmly. This is subsequently not disturbed. The entire extremity is shaved from the groin to the midleg, cleansed with ether and alcohol, painted with tincture of merthiolate, and wrapped in a sterile towel. In the operating room the chemical preparation is repeated with care not to draw sponges from the lower portion of the field toward the site of operation. The area previously bandaged is redraped, bandaged, and covered with a sterile stockinet. The draping is carried out so as to allow free movement of the extremity.

*Fashioning of the flaps.* The operator stands facing the medial aspect of the knee joint. The joint is flexed about 15 degrees, held laterally by the first assistant, and supported in slight flexion by the second assistant. The flaps are marked out as follows: A scratch is made 3 fingers' breadth above the upper limit, respectively, of the medial and lateral epicondyles to mark the proximal limits of the incision; another about 1 centimeter above the tibial tuberosity to mark the distal limit of the anterior flap; a fourth in the center of the posterior aspect of the upper third of the leg at the same level as the distal limit of the anterior flap, to mark the distal limit of the posterior flap. The flaps are fashioned as shown in Figure 1

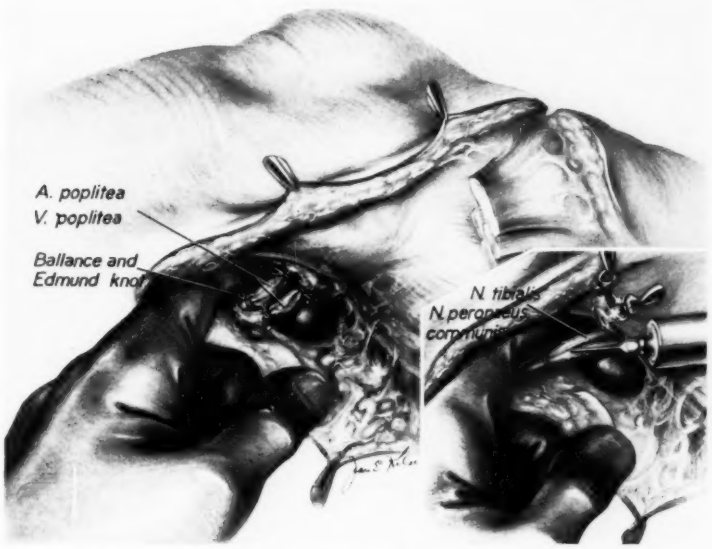


Fig. 3. Treatment of vessels and nerve. The popliteal vessels are withdrawn from the wound and cleansed of extraneous tissue. The adventitia is stripped of both artery and vein for a distance of about 1 inch. The distal portion of the vein is ligated first with No. 1 silk. The proximal portion of the vein is then ligated. The artery is treated by placing a Ballance and Edmund knot on the proximal end and an ordinary ligature on the distal end. Section is made between ligatures. The inset shows the tibial and common peroneal nerves cleansed of surrounding tissue and ligated high with a ligature of No. 0 plain catgut. A fine needle is shown inserted for the injection of absolute alcohol. The divided blood vessels are visible. Section of the nerve is performed through the alcoholized area. It may be necessary to ligate the distal portion of the nerve to control bleeding from the arteria comitans nervi ischiadici.

with scratches used as landmarks. Note that from the proximal limits the anterior and posterior incisions diverge promptly and form flaps of equal size and shape. This allows for more accurate approximation without the sacrifice of the cardinal principle of absolutely loose flaps. It seems that retraction of the posterior flaps is greater in thin extremities than in those with more subcutaneous tissue. It is wise, therefore, to make the posterior flap about 1 centimeter longer in thin individuals. Should amputation be desired through the bone, from 2 to 4 inches above the epicondyles, the flaps are merely fashioned at a correspondingly higher level. The incisions are developed through the skin, subcutaneous tissues, and deep fascia both on the anterior and posterior flaps.

*Tenotomy of medial hamstrings.* The tendinous insertions of the hamstring muscles on the tibia are exposed and sectioned as shown in Figure 2. These tendons should not be mobilized above the site of section. If the amputation is to be done well above the epicondyles, the site of section should be high in the purely tendinous portion of the muscles. Thus the attachments of musculus sartorius, gracilis, semimembranosus and semitendinosus are divided.

*Entry into the popliteal fossa and treatment of vessels and nerve.* The cleft between the vastus medialis and the sartorius is deepened, the deep fascia is split, and the popliteal fossa entered. The forefinger is inserted with its dorsum uppermost, hooks around the popliteal artery and vein, and draws them out into the superficial tissues. The delivery of the vessels and nerve is facilitated by maintaining the knee in slight flexion. The vessels lie close to the posterior surface of the femur (Figs. 3 and 9). The vein is treated first so as to prevent contaminated blood from feeding the general circulation. It is freed from the artery by sharp and blunt dissection, its adventitia removed for a distance of about 1 inch and the vein sectioned between two ligatures of No. 1—Deknatel—silk applied with carrier. The artery is similarly

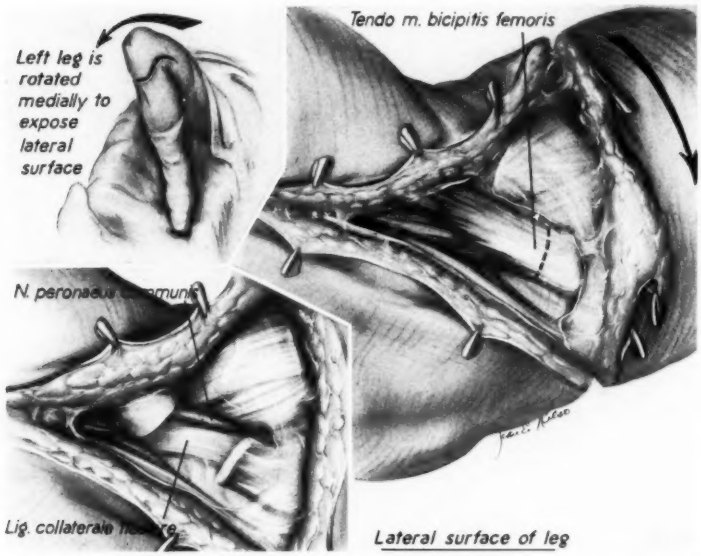
Left leg is rotated medially to expose lateral surface
Tendo m. bicipitis femoris
N. peroneus communis
Lig. collaterale fibulare
Lateral surface of leg

Fig. 4. Section of tendon of the musculus biceps femoris. The knee is rotated toward the operator to expose the lateral surface of the joint. The tendon of the biceps femoris is shown and its site of section indicated. Some of the tendinous fibers of the iliotibial tract must be divided. The upper inset shows how the leg is rotated toward the surgeon. The lower inset shows the biceps tendon sectioned and the common peroneal nerve exposed. This nerve has already been treated higher in the popliteal fossa.

denuded and sectioned between ligatures of the same material, except that the proximal portion is best ligated with a Ballance and Edmund knot, two contiguous strands of the same material being used (Fig. 3). This knot does not slip easily and tends to prevent fracture or cutting of the arterial wall. A carefully placed ordinary triple throw square surgical knot may be used if desired. If the artery pulsates it is wise to anchor the proximal ligature with a through-and-through embracing mattress suture of B—Deknatel—silk through all the arterial coats. If the vessel is soft and transmits considerable blood, it is best to compress it temporarily above while the ligature is being slowly drawn home, care being taken not to fracture the arterial coats with too much force. The tibial and common peroneal nerves are then withdrawn as one trunk from the popliteal fossa and cleansed of all extraneous tissue. The nerve trunk is ligated as high as possible with No. 0 plain catgut, injected distal to the ligature with absolute alcohol (Fig. 3, inset), and sectioned with a razor blade. The ligature serves the triple purpose of (1) preventing bleeding from the arteria comitans nervi ischiadici, which is a greatly augmented collateral in chronic occlusions of the femoral artery, (2) preventing alcohol from traveling up the nerve, and (3) keeping the effect of the alcohol localized. When higher amputation is contemplated, section of vessels and nerve is made correspondingly higher.

*Tenotomy of musculus biceps femoris.* Without changing his position the operator rotates the extremity toward him to expose the lateral side of the knee joint (Fig. 4). The cleft between the biceps femoris and the iliotibial tract is deepened and the biceps traced to its insertion, the skin flaps being dissected so as to give the necessary exposure. The biceps is sectioned through its tendon (Fig. 4), but at times the muscle fibers come very low and a few must be cut as the tendon is sectioned.

*Scalping back of the anterior flap and mobilization of the posterior flap.* The dissection of the anterior flap is then carried through the deep fascia to the tissue compartment between the deep fascia and the ligamentum patellae. The scalping procedure can now be executed with dispatch. The surgeon grasps the free end of the anterior flap gently but firmly in both hands and scalps the anterior flap in a single sweep back to the level of the superior border of the patella (Fig. 5). There

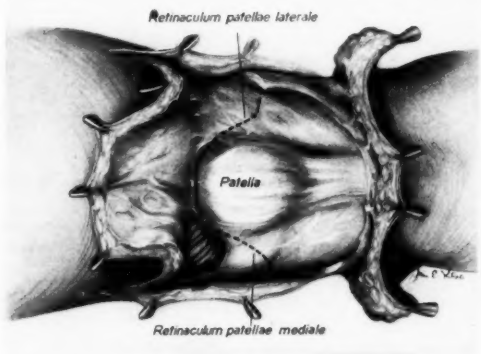


Fig. 5. Scalping back the anterior flap. The anterior flap has been scalped backward and the superior border of the patella exposed. The site of section of the tendon of the quadriceps and the retinaculum genu are indicated.

is usually no bleeding. The incision marking the posterior flap is deepened to the fascia covering the gastrocnemius and dissected free of the muscle up to a point above the attachments of the gastrocnemius heads.

*Entering of the knee joint through the suprapatellar bursa and section of the retinaculum genu.*[1]

[1]Otherwise known as retinaculum patellae, mediale or laterale. Author prefers "genu" as structure in mind is associated more with knee joint proper than with patella alone and extends far laterally and distally from patella.

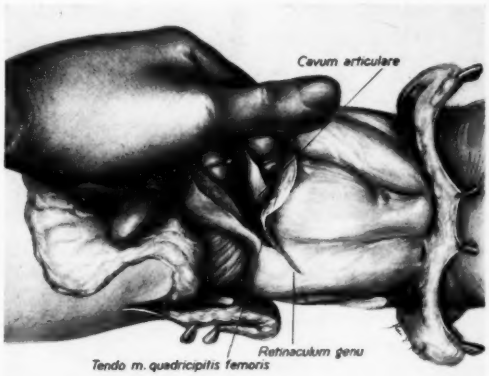


Fig. 6. Section of tendon of the musculus quadriceps femoris. Entry into bursa suprapatellaris genu. Section of retinaculum genu. The suprapatellar bursa of the knee joint has been exposed by an incision through the quadriceps tendon. The fingers are shown inserted into the knee joint to facilitate section of the retinaculum.

The anterior flap is held cephalad and a curved incision is made close to and parallel with the superior border of the patella, in the midline passing through the thick tendon of the musculus quadriceps femoris into the suprapatellar bursa. The knee joint is thus entered. As the incision curves laterally the tendinous attachment of the iliotibial tract is divided. Two fingers are then inserted into the knee joint through the suprapatellar bursa, first on one aspect, then on the other; the retinaculum genu is lifted up and cut

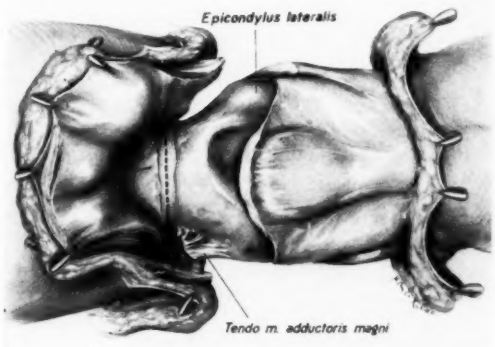


Fig. 7. Exposure of site of proposed amputation. Preparation of bone for section. The posterior flap has been dissected free of the gastrocnemius muscle to above the gastrocnemius heads. The retinaculum genu has been cut. The tendon of the adductor magnus has been sectioned. The areolar tissue and periosteum covering the bone have been divided and dissected for a distance of about 1 centimeter at the site of proposed amputation. Gauze tapes covering the soft tissue above and below the site of section are omitted for purpose of clarity.

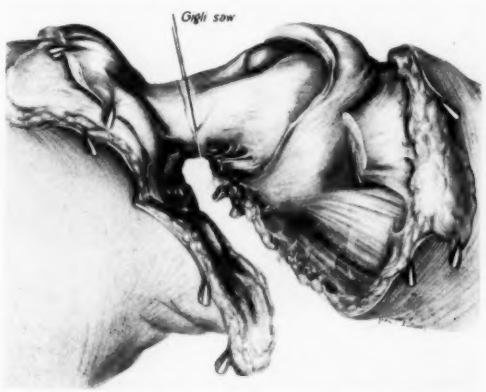


Fig. 8. Amputation is performed throughout the medullary portion of the bone about 2 centimeters above the adductor tubercle. The gauze tapes which protect the soft tissue from bone dust are purposely omitted from the drawing.

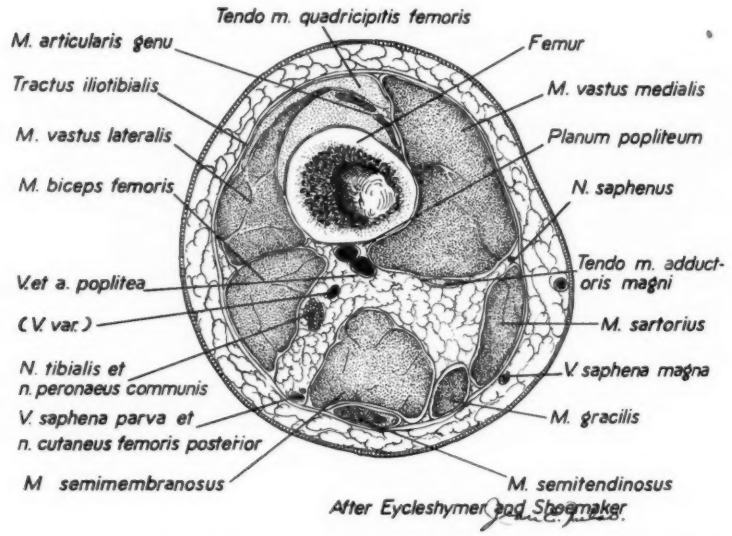


Fig. 9. Cross section at the site of amputation showing the somewhat rounded femur. The proximity of the popliteal vessels to the posterior surface of the femur is apparent. The nerve is shown lying posterior and lateral to the vessels.

over the space between the separated fingers as shown in Figure 6. The medial retinaculum must be sectioned more distally than the lateral retinaculum to avoid the low-lying muscular fibers of the vastus medialis. The surgeon then sections the tendon of musculus adductor magnus or its lower musculotendinous attachments to the femur up to the level of the proposed section of the femur (Fig. 7). This procedure divides the last remaining tissue below the site of amputation except the bone, the synovia of the knee joint, and the areolar tissue immediately surrounding it.

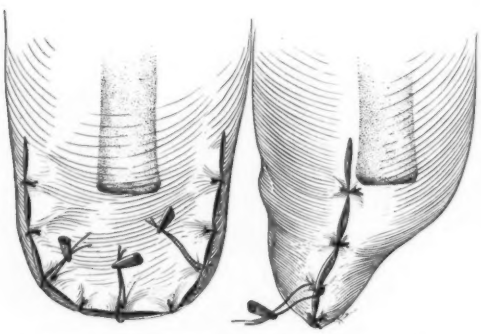

Fig. 10. Appearance of stump at conclusion of operation. Closure is effected by approximating skin and subcutaneous tissue only. Interrupted silk sutures are placed at about 3 centimeter intervals. The first 2 sutures adjoining the proximal limit of the suture line are tied in the usual manner. The rest of the stump is closed by tying every other stitch. The untied stitches have a single loose knot. After drainage has completely stopped these are tied.

*Section of the bone and treatment of the bone end.* Until recently artificial legs were usually suspended from shoulder straps, and the retention of the beginning condylar flare was a great aid in anchoring the stump well down in the socket of the prosthesis. More recently, however, improved ischial supports have eliminated the tendency of the stump to leave the socket and have allowed us to cut the bone at a slightly higher level where it is more round or oval. This site is usually about 2 centimeters above the adductor tubercle. Although it is through the medullary portion of the femur, the ability to bear the body weight directly on the end of the healed stump is in no way impaired. This produces a conical stump which contains no protuberances to act as favorite sites for the development of pressure sores. The removal of an additional three quarters of an inch of bone length is of no importance in such a low amputation.

The sectioned tissues of the thigh and leg are now completely covered with warm, moist tapes, and the lower femur is left free. The site having been selected it is marked by a circular incision

through synovia, areolar tissue, and periosteum, all of which are freed from the bone with periosteal elevator for about 0.5 centimeter. In amputation for vascular disease denudation of the bone is avoided as much as possible. The tendency to strip the muscles from the bone should be carefully restrained. The bone is then sectioned with Gigli saw in a direction perpendicular to the long axis of the thigh (Fig. 8). Special care is necessary to keep the saw in the desired plane. The second assistant steadies the leg and knee as the surgeon slows down to saw through the last portion of the bone to prevent fracture of the stump. The leg is then removed. The edges of the bone end are rounded with a coarse file. If bleeding occurs from the marrow it should be carefully controlled by pressure or bone wax. Failure to do so has caused hematoma of the stump which resulted in delayed healing. The tapes, now contaminated with bone dust, are removed.

*Irrigation, hemostasis, and closure.* The entire stump is now thoroughly irrigated with warm salt solution. Scrupulous care is exercised to ligate every bleeding point. The tendency to oozing is considerable because of the lack of tension in the closure. As the flaps are inspected they are found to be quite loose, extending 2 to 4 centimeters past the bone end (Fig. 10). They should not be trimmed. The closure consists only in approximating the skin and subcutaneous tissues with interrupted sutures of No. 1 silk about 2 inches apart. Between these, additional sutures are placed and loosely tied with one knot. A dressing is applied to the stump which gives even and firm pressure and which tends to draw the suture line posteriorly. Special care is taken to obliterate the posterior space by an extra pressure pad. The whole stump is wrapped in oiled silk so that the lower end is free for ventilation. The protection is advisable in order to prevent contamination from urine.

In a few cases the closure was modified by making a 2 inch incision in the center of the posterior flap for drainage and by completely closing the skin incision. The drainage opening did not function well and allowed serum and blood to accumulate in the stump. It was therefore abandoned. The author finds the method detailed more satisfactory.

*Postoperative course.* The patient is placed in a bed fitted with a Balkan frame and hand trapeze. He is encouraged to move the stump as soon as possible. The stump is allowed to rest horizontally; it is not elevated lest flexion contracture result. For about 3 to 4 days it is normal for the stump to drain a large amount of serum. Dressing is done on the third day. Only when the discharge of serum has ceased are the sutures previously placed tied. At the first dressing it will be noted that the skin has contracted so as to fit more or less snugly about the bone end, and the hamstrings have drawn the suture line well posteriorly. Sutures are removed on the tenth or twelfth postoperative day.

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# CYCLIC CHANGES IN THE MAMMARY GLAND OF THE RHESUS MONKEY

## Preliminary Report

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SINCE the classical demonstration by Hitschmann and Adler (1908) of histological alterations in the human endometrium during the menstrual cycle, similar rhythmic changes have been sought in other portions of the reproductive tract. In addition to the numerous local and systemic physiological and biochemical changes which have been correlated with the bleeding cycle (Ehrenfest, 1937), structural alterations of a cyclic nature have also been described in the mucosa of the fallopian tube (Snyder, 1924), cervix (Wollner, 1937), and vagina (Dierks, 1927).

A large and controversial literature has arisen concerning the existence and nature of changes in the human breast in relation to the menstrual cycle. It has long been known that many women experience a sense of fulness and an increase in the size of their breasts before the onset of each menstrual flow. This well established phenomenon has recently been demonstrated in a more or less quantitative fashion. Reimann and Seabold (1933) measured the areas of x-ray silhouettes of the breasts of women at various stages of their cycles and found a premenstrual increase in size, with a decrease during the postmenstruum. Geschickter (unpublished), with the aid of an ingenious funnel-shaped apparatus, has been able to demonstrate volumetrically an increase in breast size antedating the onset of menstruation, with a corresponding postmenstrual decrease.

The first attack upon the problem of the histological changes during the cycle was the report of Rosenburg (1922). On the basis of his study of breasts obtained at autopsy he constructed a very definite cycle for the human mammary gland. This consisted of a premenstrual proliferation and budding of the ducts, with canalization of the buds at menstruation. During the postmenstrual period regression occurred, so that by day 10 of the cycle the lobules had completely disappeared and only the ducts remained. Polano (1924) made a study of human biopsy specimens and agreed in principle with Rosenburg but found wide individual variations in the degree of postmenstrual regression, which prevented him from regarding the cycle as so definite and striking a phenomenon as had Rosenburg. Ernst (1925), Berberich and Jaffé (1925), and Sebening (1925) also accepted, with minor modifications, Rosenburg's idea of the cycle, each author basing his conclusions upon histological study of autopsy material.

Dieckmann (1925) criticized severely the interpretations of Rosenburg and found it possible to rearrange the latter's cases so that the histological picture of each could be correlated with the age of the patient rather than with the menstrual cycle. Dieckmann regarded the lobular development seen in some specimens as due to the greater age of the patient, and strongly objected to the idea of a postmenstrual regression of the lobules. He did, however, describe a premenstrual lobular swelling or "Lappchenoedem," with subsequent shrinkage of the lobule during the interval. Moszkowicz (1926) examined a series of biopsy specimens obtained at operation for various types of mammary disease and confirmed the premenstrual edema of Dieckmann, describing in addition a premenstrual infiltration of round cells in the lobules with regression during the interval. Subsequent writings have done little to clarify the situation. Luchsinger (1927), for example, confirmed the findings of Rosenburg but was able to find the lobular edema of Dieckmann only in exceptional cases, while Kueckens (1929), after examining sections from more than a hundred human glands of various ages, found no definite cycle of any type. More recently Lewis and Geschickter (1934) expressed agreement with the composite ideas of Rosenburg, Dieckmann, and Moszkowicz, describing cyclic changes in the parenchymal elements and in the degree of lobular edema and of cellular infiltration. Ingleby (1932) had even made the statement that "premenstrual proliferation is much more rapid than carcinomatous growth." Taylor (1936), however, after reviewing the literature and on the basis of his own studies, was unable to accept the theory of a parenchymal cycle, although he did observe cyclic changes in the stroma. Friedman, Finkler,

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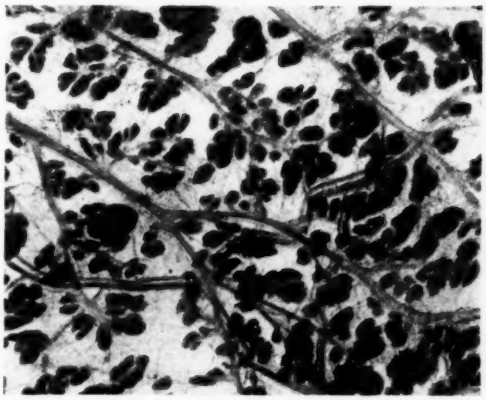

Fig. 1. Biopsy specimen of monkey mammary gland at day 22 of cycle, 11 days after the occurrence of ovulation. Whole mount; alum cochineal. ×7.5.

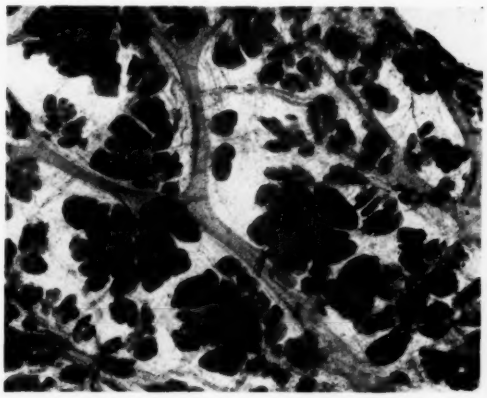

Fig. 2. Mammary biopsy specimen, same animal 5 days later, showing lobular enlargement during premenstruum of ovulatory cycle. Whole mount; alum cochineal. ×7.5.

and Antopol (1939) likewise were unable consistently to correlate the histological pictures of 45 biopsy specimens with the specific stages of the menstrual cycle.

In addition to these claims for, and denials of, cyclic changes in the histology of the human mammary gland, Pallot (1935) has reported an increase in the height of the epithelial cells during the premenstruum and a concomitant swelling of the myoepithelial cells, and Grynfeltt (1938) has described the appearance of lipoid granules in the alveolar cells during the same period.

In summary, cyclic changes have been described in the human mammary gland with respect to epithelial proliferation and lobular growth, the size of the epithelial cells, the lipoid granules within the cells, and the degree of edema and of cellular infiltration within the stroma. Because of the marked disagreement in the literature with respect to the existence and extent of the various cyclic changes described, the status of the problem is unsatisfactory at present.

There are several difficulties, some seemingly insuperable, incumbent upon attempts at settling the question of a cycle in the human mammary gland. Due to the conical shape of the human breast and its large quantities of fat and connective tissue, the mammary gland can be studied only in histological section and is not adaptable to study in whole mounts, as is possible in many laboratory mammals. Thus a gross view of the lobules and their arrangement cannot be obtained. Because of the necessary reliance upon histological sections, only limited portions of the gland can be examined, and it is generally accepted that marked variations may exist simultaneously in different parts of the same human breast. In most studies, furthermore, attempts have been made to compare the glands of different women, thereby introducing the additional complicating factor of individual variation. Of great importance is the fact that practically all studies have been based upon the examination of mammary tissue the normalcy of which may be seriously questioned; that is, tissue obtained at autopsy after death from a variety of causes, or biopsy specimens from breasts which were being operated upon for pre-existing mammary pathology, such as neoplastic or cystic disease. Moreover, in most instances only the day of the menstrual cycle was known, and rarely was this correlated with studies of sections of the endometrium. The occurrence and relative frequency of anovulatory menstrual cycles in the human is becoming more generally recognized, and it will therefore be evident that in the absence of endometrial biopsy or urinary pregnandiol assays, essential data are lacking for the proper interpretation of cyclic changes in the mammary gland. For without such information one has no knowledge of the presence or absence of a functional corpus luteum, an organ of great importance in mammary physiology.

The question of a mammary cycle has not been investigated in subhuman primates. The rhesus monkey would appear to be the ideal animal from which to obtain evidence of possible applicability to the human; for in addition to the similarities in the menstrual cycle and the reproductive physiology of the two species, the macaque mammary gland is subject to none of the objections which have been raised against the interpretation of human material. Whole mounts can readily be

made of the monkey mammary apparatus, either of the whole gland or of biopsy specimens; and since the gland of the intact animal is, as a rule, quite uniform in structure, as has been found in an examination of more than 200 pairs of mammary glands, a specimen of sufficient size may be considered as representative of the entire gland. By using rhesus monkeys one can perform repeated biopsies upon the same animal, free of mammary pathology and accurately dated with respect to the menstrual cycle. In addition it has been possible to ascertain and time the occurrence of ovulation during the cycle, by means of recto-abdominal palpation (performed by Dr. Carl G. Hartman).

Nine monkeys having regular menstrual cycles were studied by biopsies performed on alternate breasts at intervals of about one week. Daily vaginal lavages were made to determine the onset of menstruation, and bimanual palpation for the ascertainment of ovulation. In addition several laparotomies were performed to check the diagnosis of ovulation. Thirty-nine biopsies, covering 7 ovulatory and 6 anovulatory cycles, were studied by means of whole mounts and histological sections.

From examination of the whole mounts it is possible to establish the existence of a definite series of cyclic mammary changes which bear a fixed temporal relation to the menstrual cycle. Beginning 7 to 10 days before the onset of the menstrual flow the lobules begin to enlarge, and in some instances the individual acini appear to dilate. Premenstrual lobular swelling has been observed to occur with varying rapidity; in some cases definite changes were found in specimens removed a few days apart. Figure 1 is the whole mount of a biopsy specimen obtained on day 22 of the cycle, 11 days after ovulation. Figure 2 is a mammary specimen, at the same magnification, taken from the same animal 5 days later. Since hysterectomy was performed at the time of the first biopsy, for purposes of another study, menstruation did not set in at the expected time. The enlargement of the lobules is readily apparent.

These changes attain their height at about the time of menstruation and slowly regress during the postmenstrual period and interval. They have been found, however, only in those cycles in which ovulation has occurred. In anovulatory cycles, no lobular enlargement has been observed, and little if any change can be detected during the premenstruum.

Study of the histological sections has confirmed, in general, the changes noted in the mounts. Enlargement of the acini was seen soon after ovulation and persisted throughout the premenstrual period, gradually subsiding during the early part of the next cycle. This premenstrual enlargement of the acini was not found among the anovulatory cycles. Another rather striking contrast between the ovulatory and anovulatory cycles was found in the degree of vascularity of the lobules. During the premenstrual stage of a cycle in which ovulation had occurred, many widely dilated capillaries, filled with red blood cells, were seen in the interacinar spaces. Little if any vascular changes could be detected during anovulatory cycles. No definite changes could be made out regarding the degree of cellular infiltration of the lobules at different stages of the cycle.

In summary, a cycle, dependent upon the occurrence of ovulation, has been established for the mammary gland of the rhesus monkey. The striking features of the cyclic changes are the enlargement and the increase in vascularity of the lobules and the dilatation of the acini during the premenstrual and menstrual periods.

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# POSTPARTUM PYELOURETERAL CHANGES FOLLOWING HORMONE ADMINISTRATION

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CONSIDERABLE divergence of opinion exists concerning the etiology of ureteral dilatation during pregnancy.

The study of the urinary passages in pregnancy has been greatly facilitated by the discovery of radio-opaque substances, by means of which the urinary tract can be visualized directly on the x-ray plate. Kretschmer, Heaney, and Ockerley (19, 20), Lee and Mengert (22, 25), Dugald Baird, Duncan and Seng, and numerous other workers, by means of intravenous and retrograde pyelograms, found some degree of dilatation of the upper urinary tract in every pregnancy—100 per cent on the right side and 85 per cent on the left. The earliest attempt at explaining so universal a change occurring during normal pregnancy was made by Opitz in 1905. He believed that the dilatation of the ureters during pregnancy was caused by pressure of an enlarging uterus on the ureters. Baird performed autopsies upon 102 women, who died during pregnancy or within a few days of delivery, and found that the right ureter in the later months of pregnancy was frequently compressed between the uterus and the psoas muscle or the common iliac artery on that side. The left ureter was afforded some degree of protection by the more posterior position of the common iliac artery and because the ureter follows a more or less parallel course to that vessel rather than crossing it at right angles. Further protection was afforded by the promontory of the sacrum and the cushion-like effect of the sigmoid colon. Similar observations have been made by Carson, Hundley, and others. In quadrupeds this pressure factor, for the most part, is low (Crabtree). Mengert (24), after a study of pregnancy in the cow, rabbit, guinea pig, rat, hog, and monkey, concluded that the ureters of these animals did not dilate during pregnancy. However, dilatation of the ureters has been recorded during pregnancy in animals, and these changes are recognized in veterinary medicine. Dilatation of the ureters has been observed in the rabbit by Rossi, and in the monkey by Van Wagenen and Jenkins.

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Baker and Lewis studied 16 cases of ovarian cysts and fibroid uteri, all larger than the size of a 3 months' pregnancy, by means of intravenous pyelograms. They found bilateral ureteral dilatation in 63 per cent, and right sided dilatation alone in 37 per cent of the series. Dilatation of the urinary tract was found to disappear with the removal of the tumor in all cases. Similarly, Kretschmer and Kanter (21) found changes in the urinary tract in 64.7 per cent of gynecological disorders, including fibroids, ovarian cysts, and prolapse of the uterus. Following surgery, 72.5 per cent of these cases return to normal.

From studies of frozen sections of pregnant women at term, Hofbauer (16, 17) concludes that the probability of ureteral pressure as an etiological factor in causing ureteral dilatation has been shown to be untenable. In a complete histological study of the urinary tract at various levels, Hofbauer found both hypertrophic and hyperplastic changes in the musculature and connective tissue of the pelvic portion of the ureter. These changes histologically resemble those occurring in the lower uterine segment during pregnancy. A striking feature of Hofbauer's study was the finding of excessive hypertrophy of the external longitudinal ureteral sheath of Waldeyer.

Traut, McLane, and Kuder (27, 28, 29), in a series of experiments, described a progressive decrease in peristaltic activity and tone of the ureters as pregnancy advanced, up to the seventh month, after which time a definite return of muscular irritability was observed. By means of intravenous pyelograms, they found that the degree of ureteral dilatation is proportional to the diminution of ureteral activity. Following close on the returning irritability of the ureteral musculature, dilatation was found to be less marked as term approached. They believe this loss of tone and irritability to be contributory to the dilatation of the ureters, i.e., atony is primary, with dilatation a secondary development, the whole process being affected in varying degree by the weight and torsion of the pregnant uterus. Traut and McLane suggest that the etiology of ureteral atony, hence, ureteral dilatation, may be chemical.

The mechanical pressure theory cannot adequately explain the diminution of ureteral dilatation during the last weeks of pregnancy when the uterus is approaching its maximum size.

The observations here noted are suggestive of other factors apart from obstruction, which influence the behavior of the ureters during pregnancy.

In the past few years various European and American workers have studied the influence of various hormones on ureteral contractility, irritability, and dilatation.

Bompiani, working with isolated animal ureters kept alive *in vitro*, demonstrated increased peristalsis of the ureter with human pregnancy urine of the second month and a marked decrease of motility with pregnancy urine of the eighth month. Corpus luteum and folliculin were found to inhabit peristalsis, whereas gonadotropic hormone increased motility. Grossu-Streja and Georgesco, using isolated pig ureters, also obtained inhibition to ureteral peristalsis by the use of folliculin and corpus luteum hormones, but, unlike Bompiani, observed inhibition also with gonadotropic hormone. Contiades, Villaret (9, 10, 31, 32), and their co-workers found inhibition of ureteral muscular activity of isolated dog and cow ureters with folliculin, corpus luteum hormone, amniotic fluid, and term urine which had been boiled in order to destroy its prolan content. They also mention 2 cases of pregnancy with diabetes insipidus in which the urine caused decreased rhythm of contraction, the action of which strongly resembled that of folliculin. Further, they found that both anterior and posterior pituitary extracts caused acceleration of peristaltic activity.

Rossi, by means of intravenous pyelograms, found that the appearance of the best plates in pregnant rabbits near term is obtained 15 to 20 minutes after injection of the dye, while in the adult, nonpregnant rabbit the best plates were obtained in 3 to 4 minutes. Interestingly enough, he also reports a less marked dilatation of the ureter just before delivery. Rossi injected serum from the blood of pregnant rabbits near term into nonpregnant female rabbits and obtained delayed maximum visualization of the urinary tract up to from 15 to 20 minutes. He also found a progressive increase in ureteral dilatation in these animals up to 72 hours, after which time regression of these changes occurred. Crabtree, Abramson, and Robins confirmed the finding of Rossi of delayed appearance of the best plates in pregnant rabbits after intravenous injection of diodrast.

Brack and Langworthy (4, 5), who demonstrated an increased vesical capacity in rabbits during pregnancy, showed a similar increase in 50 per cent of their cases 10 days after injection of antuitrin S intravenously. They also found a slight decreased vesical capacity 1 week after injecting progynon B, followed in 2 to 3 weeks after injection by an increase in average capacity.

After the prolonged administration of estrogenic hormone in both male and female mice, Burrows found dilatation of the urinary bladder and ureters with hydronephrosis, sometimes accompanied by a purulent cystitis and pyelitis.

Draper, Darley, and Harvey reduced the size and density of pelvic and ureteral shadows, as shown by intravenous pyelograms, by intramuscular injections of pituitary extract and pitressin.

Dugald Baird found that in cases of toxemia the amount of ureteral dilatation was consistently slight. This observation he interpreted to be the result of a probable overproduction of posterior pituitary hormone in toxemia, thus accounting for the lack of atony.

Van Wagenen and Jenkins, in a study of factors causing ureteral dilatation in pregnancy, attempted to remove the mechanical factor by removing the fetuses of pregnant monkeys by cesarean section in various periods of gestation. The hormonal relationships were preserved by leaving the placenta undisturbed in the uterus. They found that dilatation of the upper urinary tract can develop after removal of the fetus while the placenta remains in a functional state within the uterus. This dilatation disappeared only after the placenta separated and was delivered spontaneously at the end of a period of time which corresponded to the end of the normal period of gestation in the monkey.

In view of the reports presented we were of the opinion that additional information could be gained by analyzing the effects of various hormones upon the postpartum ureter. This physiological dilatation of the genitourinary tract regresses fairly rapidly to normal in the postpartum period. Kretschmer and Heaney (19), Ockerley (20), and Hundley and his co-workers found that 96 per cent of their cases regressed to normal by the sixth week postpartum. Lee and Mengert, and Duncan and Seng state that a majority of their cases regressed to normal by the ninth postpartum day.

In a series of 10 cases McConnell and Gray found 2 cases returned to normal, there was a reduction of dilatation in 2 cases, while in 2 others there was a very definite increase in dilatation in a period of less than 10 days postpartum.

With these results as a guide, we believed that any consistent deviation in the rate of involution of the postpartum ureter in a group receiving a hormone preparation might possibly be caused by the specific effects of the hormone administered. In the postpartum period the kidney pelvis and ureter can easily be visualized, and it was believed that this was a safe period in which to administer the various hormone preparations used, some of them in fairly large doses.

### METHOD

All the cases studied in this series were selected. The patients were all primiparous. In no patient was there any history of previous genito-urinary disease. The antepartum urine examinations were all negative for albumin and white blood cells. None of the patients had signs or symptoms of toxemia of pregnancy, nor did any of them have hypertension. The ages varied from 17 to 28 years. Only patients who had spontaneous or outlet forceps deliveries were included. Intravenous pyelograms after the administration of 20 cubic centimeters of diodrast were taken in all cases during the first 24 hours after delivery, 7 days postpartum, and, lastly, as close to the 6 week postpartum period as was possible in those patients who returned for follow-up.

In this series 30 patients were studied; they were divided into 5 groups of 6 patients each, in the following order:

The first group was used as controls, no hormone being administered.

The second group was given 1 cubic centimeter (10 international units) of posterior pituitary extract intramuscularly, daily for 7 days.

The third group received 1 milligram (1 international unit) of progestin in oil intramuscularly, daily for a period of 7 days.

The fourth group was given 1,000 rat units of anterior pituitary-like hormone daily for 7 days, subcutaneously.

The fifth group received 5 milligrams of stilbestrol orally, daily for a period of 7 days.

The hormones mentioned were administered during the first 7 days postpartum, in the interval between the first and seventh day pyelograms.

### SIDE EFFECTS

A total of 75 pyelograms were taken with no harmful effects, aside from mild nausea in an occasional patient. In the patients who were given stilbestrol there was a definite diminution in the amount of lactation in 4, and in 2 the breasts dried up completely by the fifth postpartum day. Marked acne of the face improved remarkably in 1 patient who was given stilbestrol. However, the acne was again marked when the patient was seen 6 weeks postpartum, during which time she had not received stilbestrol. No changes in involution of the uterus were noted in the groups treated with stilbestrol and anterior pituitary-like hormone. In the group of 4 patients who were given progestin there was definitely slow involution of the uterus, and in this group was the only patient in the entire series who developed a low-grade endometritis.

### RESULTS

In the series of 30 patients studied within 24 hours following delivery, some degree of dilatation of either the kidney pelvis or the ureter was observed in 30, or 100 per cent, of the patients. Dilatation was noted on the right side in 29, or 96.6 per cent, and on the left side in 14, or 46 per cent. The right side alone was involved in 16, or 53 per cent, and the left side in 1, or 3.3 per cent. In the repeat pyelograms on the seventh day postpartum, 9, or 30 per cent, of the patients who previously had had some slight, moderate, or marked degree of dilatation of the kidney pelvis or ureter had already returned to normal. Four, or 13.3 per cent, revealed pronounced regressive changes, with the ureter and pelvis almost approaching the normal. Six, or 20 per cent, revealed moderate to slight regressive changes; all these patients showed some degree of improvement in appearance of the pelvis and ureter over that of the first plate. Eleven, or 36.6 per cent, showed either no changes or a slight degree of increased dilatation of the ureter or kidney pelvis. Only 13 of the patients in this series returned at the end of 6 weeks for a final pyelogram, and all these were found to have normal appearing plates.

### CONTROL GROUP

In this group 2 patients returned to normal within 1 week. One of these patients had moderate ureteral and pelvic dilatation on the right side, and the other a marked degree of ureteral and pelvic dilatation with moderate hydronephrotic changes, also on the right side. In 3 patients no changes were found at the end of 1 week. One of these had a bifid ureter and pelvis on the right side and developed a postpartum pyelitis on the fourth day which persisted up to the seventh day. At the end of 6 weeks this patient had a normal pyelogram. In this group there was 1 patient who showed moderate regressive changes on the seventh day.

### POSTERIOR PITUITARY

The group of patients who received posterior pituitary extract revealed the most striking results in the entire series. In these 6 patients pyelograms were completely normal in 4 on the seventh day, and in the other 2 patients—both of whom had marked ureteral and hydronephrotic changes—pyelograms were almost normal in appearance except for slight dilatation of the renal pelvis.

One patient in this group developed a bilateral postpartum pyelitis on the second day which lasted until the seventh day. This patient had chills, fever, (temperature 104.2 degrees), some pain in the back, dysuria, and a moderate degree of bilateral costovertebral tenderness. Examination of the urine disclosed 2 plus albumin and numerous white blood cells, singly and in clumps. Pyelograms of this patient on the seventh day and 6 weeks postpartum were entirely normal.

### PROGESTIN

The results obtained in this group were also impressive, but in an opposite direction. Pyelograms of 5 of these 6 patients at the time the second plate was taken revealed either no changes at all or some increased dilatation of the kidney pelvis and ureter on one or both sides. In 3 patients there was slow involution of the uterus, and in 1 patient slow involution with a mild endometritis (temperature 100.6 degrees on the sixth day, and 101 degrees on the seventh day). In only 1 patient of the entire group were there evidences of a regressive nature. In none of these patients was the pyelogram normal on the seventh day. One patient had a normal pyelogram in the sixth week postpartum.

### ANTERIOR PITUITARY-LIKE HORMONE

A study of the seventy day plates of this group demonstrated that the ureters and kidney pelvis more closely approached the normal than did those in the nonmedicated group. Two patients with moderate dilatation of the ureters and kidney pelvis during the first 24 hours were found to have a normal appearing genito-urinary tract on the seventh day postpartum. Two patients showed marked regressive changes on the seventh day. One of these developed a left pyelitis on the sixth day. Pyelograms of this patient on the seventh day disclosed a normal kidney pelvis and ureter on the right side and slight regressive changes on the left side. One patient showed no changes in the appearance of the urinary tract during the first week, while another showed moderate regressive changes on the seventh day. Pyelograms of both these patients were normal 6 weeks postpartum.

### STILBESTROL

The results obtained in this group were similar to those in the group that received no medication. In 1 patient with marked dilatation of the pelvis and ureter on the right side there was normal involution by the seventh day. In 3 patients there were slight to moderate regressive changes, and 2 showed no changes on the seventh postpartum day. Three of the last 5 patients had normal appearing urinary tracts 6 weeks postpartum.

### EVALUATION

The incidence of ureteral and pelvic dilatation at 7 days and 6 weeks postpartum in the series herein reported compares favorably with results published previously, some of which are quoted here. In a period of 7 days following delivery, almost half (43.3 per cent) of the pyelograms were either normal or almost so (showing marked regressive changes), while 56.6 per cent showed slight regressive changes or no change at all. Of the patients who received no medication, 33.3 per cent returned to normal in 1 week. The remainder presented slight or no changes whatever. In the group that received posterior pituitary extract, 100 per cent of the patients returned to normal, or almost normal, on the seventh day. In none of the patients who were given progestin was there a return to normal pyeloureteral involution, nor did any of these show marked improvement during the time that they were receiving the hormone. Four patients in this group showed an increase in the size of the pelvic and ureteral shadows on the seventh day. In the anterior pituitary-like hormone group favorable changes were noted in 66.6 per cent, this being better than for the entire series and for the control group. No significant trend was observed for the stilbestrol group.

The number of patients studied in this series is small; therefore, care must be used in the interpretation of the results obtained. Fairly consistent results followed administration of posterior pituitary extract, in hastening return of ureteral tone, whereas progestin almost universally delayed this process or caused increased atony.

One might attempt at this point to associate the action of progestin on ureteral muscle, with its inhibitory action on uterine muscle. However, the physiological antagonist of progestin, namely

estrin, did not similarly exert its motility-stimulating action on the ureteral muscle, as it does on uterine muscle. A less marked effect was that of the anterior pituitary-like hormone in causing increased regressive changes. These results closely parallel those obtained by Bompiani in his animal experimentations. It might be interesting to view these results with our knowledge of hormonal relationships obtaining during the various phases of pregnancy, and the changes occurring in the genito-urinary tract during these periods of time. One might speculate on the rôle of the increasing concentration of progestin as pregnancy advances. The slight regression that occurs during the last 2 months of pregnancy might possibly be explained by a secondary rise in the prolan level, as demonstrated by Browne, Henry, and Venning in a number of patients during the last months of pregnancy.

SUMMARY

In this series 30 patients were studied postpartum in an attempt to determine the possible hormonal effects, if any, upon pyeloureteral dilatation. Accelerated return of pyeloureteral dilatation toward the normal was demonstrated following the use of posterior pituitary hormone. To a lesser degree, a similar change was noted following the use of anterior pituitary-like hormone on postpartum pyeloureteral dilatation. The results of stilbestrol administration paralleled an untreated control group. The administration of progestin was productive of very slight regression in only 1 patient, and in some instances it appeared to increase pyelo-ureteral dilatation.

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# EDITORIALS

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## AIRPLANE TRANSPORTATION OF PATIENTS

THE advantages of transporting patients in aircraft are: (1) speed and relatively short duration of flight, (2) comfort and (3) constant attendance by stewardesses who are registered nurses. The chance for recovery is improved greatly by shortening materially the time needed to bring seriously ill patients to their ultimate destination, especially if a major surgical procedure is necessary. Disadvantages of transportation by airplane are adverse weather and the necessity of good airports at the beginning and end of the flight. Transportation of patients by airplane has few absolute contraindications.

The modern commercial airplane is quiet, comfortable, heated, and has adjustable seats or berths. Well equipped medical kits as well as efficient means of administering oxygen, such as the B.L.B.[1], [2], [3] inhalation apparatus, are essential to planes transporting patients.

The onset of anoxemia among normal persons occurs at an altitude of 10,000 to 11,000 feet, therefore, it is obvious that any clinical condition which causes anoxemia, such as pneumonia, certain types of cardiac disease, fulminating infection, surgical or traumatic shock and so forth, will be borne less well at high altitudes than at sea level unless oxygen is given. Moon has emphasized the damaging effect of anoxia in the perpetuation of shock.

In considering transportation of anemic patients by airplane, it is important to remember that as the arterial blood leaves the lungs, it is normally saturated with oxygen; in cases of anemia, however, less oxygen can be carried as there is a subnormal quantity of hemoglobin with which it can unite. An anemic patient may not be cyanotic when anoxia occurs because cyanosis is a direct result of the amount of reduced hemoglobin present. Patients who have severe anemia should be given oxygen at relatively low altitudes as a prophylactic measure to prevent anoxia.

Schnedorf, Munslow, Crawford, and McClure demonstrated that concussion of the brain, with or without fracture of the skull, caused a decrease in the oxygen content of the arterial blood, and they advised oxygen therapy as a general procedure for such types of injury. Therefore, it seems advisable to administer oxygen to such patients who are being transported in airplanes. There is a slight rise in the pressure of spinal fluid among normal subjects on ascent to the high altitude of 28,000 feet, as demonstrated by Walsh and Boothby. This might result in an aggravation of symptoms in cases of certain types of intracranial

[1]Boothby, Lovelace, Uihlein. Proc. Staff Meet. Mayo Clin., 1940, 15: 194.

[2]Boothby, Mayo, Lovelace. J. Am. M. Ass., 1939, 113: 477.
[3]Lovelace, W. R. Proc. Staff Meet. Mayo Clin., 1938, 13: 646.

lesions which cause increased intracranial pressure.

According to Boyle's law, the volume occupied by a given quantity of gas is inversely proportional to the absolute pressure exerted on it. The importance of this law is clear in certain diseases when it is realized that if the relative volume of gas (saturated at 37°C.) inside the body is taken as one at sea level, it would be 1.5 at 10,000 feet, 1.9 at 15,000 feet, 2.4 at 20,000 feet, 4.0 at 30,000 feet, and 7.6 at 40,000 feet. Lovelace and Hinshaw have demonstrated on the basis of these facts the hazards of aerial transportation among certain patients who have pneumothorax. Gellenthien had discussed this possibility. A progressive decrease in atmospheric pressure produced by ascent thus will tend to increase pulmonary collapse in cases of therapeutic, spontaneous, or traumatic pneumothorax. Pleural adhesions may be subjected to sufficient tension to produce rupture; a pneumothorax of large volume can cause sufficient decompression to embarrass respiration seriously, and anyone who has recently undergone expansion of the lung after artificial pneumothorax often will complain of pain or respiratory distress. Patients who have pneumothorax should be warned of these dangers by their physicians.

As in the case of air in pneumothorax, gas normally present in the gastro-intestinal tract will expand with altitude, according to the corresponding change in atmospheric pressure. Patients being transported by airplane at comparatively high altitudes who have penetrating wounds of the stomach or intestine and intestinal distention are in definite danger, as the gas would be forced out through the openings in the intestine and carry fecal material with it, thus materially increasing the danger of peritonitis. It would be advisable to use gastric or duodenal suction by the Wangensteen method in order to keep the intestines of such patients decompressed during flight. Armstrong pointed out that patients who have large strangulated hernia or intestinal obstruction should not be exposed to high altitudes for this reason.

Patients who have symptoms of toxicity from sulfonamide compounds, especially cyanosis, symptoms referable to the central nervous system or anemia, are more comfortable during flight at 10,000 to 12,000 feet when oxygen is administered. Pilots undergoing treatment with the sulfonamide group of drugs are not allowed to fly.

After certain operations on the ear, such as the Lempert fenestration, flying is inadvisable because of the effects of the changes in pressure. The only way known at present to prevent the ill effects on patients caused by the expansion of gases would be by the use of a pressure cabin type of airplane, in which the pressure inside the cabin would be maintained at or near that of ground level.

W. R. Lovelace, II.

## THE TEACHING OF PROCTOSCOPY

MISTAKEN interpretation of proctoscopic findings can be excused, but the continued and widespread failure on the part of many otherwise careful and competent physicians to avail themselves of proctoscopy in the study of their patients is an unpardonable error of omission.

No examination of the colon is complete unless it includes stool tests (for ova, parasites, and the like; and the making of cultures), proctoscopic examination, and roentgenological study.

What does proctoscopy offer? The anal canal, the rectum, and the distal portion of the sigmoid colon are accessible to direct visualization by means of endoscopic examina-

tion. Occasionally an expert endoscopist can pass a long proctosigmoidoscope into the proximal sigmoid and rarely into the lower portion of the descending colon. For all practical purposes, however, that portion of the colon proximal to the midsigmoid cannot be seen directly, but lends itself readily to roentgenological study. Furthermore, the roentgenologist cannot study the rectum to his own satisfaction, and he frequently has difficulty with the rectosigmoid, as the terminal bowel is surrounded by a bony cage. Accordingly, therefore, proctoscopic examination must not be weighed against x-ray studies or some other means of investigation. Rather the several methods should be considered as integral parts of a thorough study of the colon.

The failure to use proctoscopy as a diagnostic procedure is one of the chief factors in a bad end-result. The two chief causes of failure in treating rectal disease, however, are tardiness on the part of the usual patient to report rectal troubles to his doctor, and the failure of the physician when a patient does seek advice to subject the patient to a complete proctoscopic examination. Thus it appears that both the public and the doctor must be further educated.

With regard to the education of the medical student, it must be pointed out that one great obstacle is the astonishing indifference of the medical faculties of many leading schools toward proctology; they are too easily satisfied with a "rectal clinic" devoted to clipping of skin tags and to the injection therapy of hemorrhoids. Medical educators could render great service to the proctologist by encouraging him to teach the medical student the importance of the use of the examining finger and of the proctoscope in his everyday practice.

One great difficulty lies in the actual teaching of the use of the proctoscope. The examiner can instruct students, house officers, and visiting physicians verbally and by allowing each one an occasional look through the proctoscope. He cannot, however, show each observer all the important things to be seen in a given case, nor can he allow each one to pass the proctoscope in this one patient, for to do so would necessitate an undue prolongation of the examination. In a large clinic, over a long period of time, however, duly assigned residents or "fellows" can be properly trained. Unfortunately, such clinics are few, and the number of students or fellows that can be accommodated on the proctologic service is small.

The rôle of color photography in visual education today is well established. Proctoscopic color photography has been delayed because of two problems: one, the provision of sufficient light, and the other, the absolute necessity of maintaining direct vision at all times to avoid any possibility of injury to the bowel. The apparatus designed by Garner with the aid of his technical adviser, Brubaker, answers the most rigid requirements of safety for the patient, and its use adds but little to the time required for a routine proctoscopic examination. The pictures enable the observer to see on the screen exactly what the examiner sees through the proctoscope.

Thus color photography has paved the way toward easier teaching and study of proctoscopy. Such pictures should serve well in the education of the medical student. They should enable us to bring to the general practitioner an accurate conception of the possibilities offered by proctoscopy in both the prevention and the early diagnosis of rectal and colonic disease. For this contribution proctologists especially, and the profession in general, should be grateful.

J. Peerman Nesselrod.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

EVARTS A. GRAHAM, St. Louis, *President*
W. EDWARD GALLIE, Toronto, *President-Elect*

*Committee on Arrangements*
LELAND S. MCKITTRICK, *Chairman;* RICHARD H. SWEET, *Secretary*

## PRELIMINARY PROGRAM FOR 1941 CLINICAL CONGRESS

THE thirty-first annual Clinical Congress of the American College of Surgeons will be held in Boston November 3 to 7, when the fellows of that great medical center will sponsor a clinical program of unusual interest. The operative clinics and demonstrations which are to be held in the hospitals will cover many phases of general surgery and the surgical specialties. Leaders of the profession from many sections of the country will participate in the panel discussions and other scientific meetings at the headquarters hotels. The Hospital Standardization Conference will attract many visitors of outstanding reputation in the hospital field. Each Congress that has been held in Boston—the first in 1915, the last in 1934—has made notable contributions to medicine and surgery. Those who attend in 1941 may anticipate a program of broad scope and interest, for the surgeons and clinicians of Boston have complete facilities at their command in the three medical schools and 30 or more approved hospitals.

### CLINICAL PROGRAM

Under the leadership of a strong and representative Committee on Local Arrangements, the clinical program for the five-day meeting is practically complete. An extensive schedule of clinics, symposia, and demonstrations is being arranged in the hospitals and medical schools which will, as usual, be the major feature of the Congress. Visiting surgeons will be given opportunity to observe and obtain first-hand information on a wide variety of surgical and related subjects, in the favorable environment of excellent hospital facilities. In the operative clinics, surgical technique, use of operating room equipment, and organization of personnel will be demonstrated. The symposia and non-operative clinics will deal with the broader, but equally important aspects of diagnosis, related medical treatment, pre-operative preparation and postoperative care. The discussions will be augmented by the presentation of clinical material. Diagnostic methods will be demonstrated by various hospital departments. Specialists in many other fields, as well as surgeons, will participate in the clinical program at the hospitals in order that the subjects may receive consideration from different viewpoints. A preliminary clinical program appears on the following pages. Several additional hospitals have been invited to prepare programs which will appear in subsequent publications and the final program.

The medical schools and their affiliated hospitals are developing a series of exhibits presenting their work in clinical investigation and the latest advances in surgical research. These exhibits will be available for study in the local hospitals during the entire meeting. Basic science departments of the medical schools will contribute to the program by arranging exhibits and demonstrations related to surgical practice. Thus the Boston institutions have much to offer in the way of a highly concentrated postgraduate course in surgery and allied subjects.

The schedule of each hospital is arranged to cover subjects in general surgery, obstetrics and gynecology, fractures, orthopedic surgery, thoracic surgery, neurosurgery, genito-urinary surgery, ophthalmology, otorhinolaryngology. Thus the visiting surgeon may readily select the clinics which he wishes to attend. Presentation of subjects under these classifications is so correlated that he will have the opportunity to devote his time continuously to clinics dealing with the spe-

cialty in which he is most interested. The clinical program as published daily will be arranged according to these classifications. Each afternoon during the Congress, the complete detailed clinical program for the succeeding day will be posted in the form of bulletins at headquarters in the Statler Hotel. On the following morning, this final program will be distributed in printed form. As much information as it is possible to obtain in advance is being published in the preliminary programs and the general program, but it is necessary that those who attend the Congress make their clinic ticket selections from the daily bulletins. This will facilitate proper selections and distribution of clinic tickets.

### SCIENTIFIC SESSIONS

Eminent surgeons and specialists, recognized as authorities in their respective fields, will address the scientific meetings to be held on Tuesday, Wednesday, and Thursday evenings in the ballroom of the Copley-Plaza Hotel. The annual oration on surgery will be given by Dr. W. Edward Gallie, Toronto, Ontario, on Tuesday evening. The Board of Regents of the College has given careful attention to the selection of speakers and subjects for these evening sessions so that a well-rounded program introducing the newer developments in general surgery and the surgical specialties may be assured.

During recent years, at both the Clinical Congress and sectional meetings of the College, panel discussions held at the headquarters hotel each afternoon have been of unusual interest. Therefore, a schedule of thirty-six of these sessions has been planned for Monday, Tuesday, Wednesday, Thursday, and Friday. Recognized authorities in the fields under discussion will lead these panels, and with the aid of collaborators especially qualified, will present the fundamental facts and direct the discussions in such a way that different viewpoints may be expressed. These sessions afford an opportunity for a larger number of surgeons to participate in the discussions and learn of the ideas and experiences of others. The general plan is for the leader to give a ten-minute presentation of the subject, collaborators to follow with brief remarks on different phases of the topic. Then as the major and final feature of each session, general discussion from the floor will be encouraged. This type of program will permit more informal discussion than usually takes place in larger general meetings. The subjects of the panels are carefully selected in order to cover many pertinent problems in various fields of surgery.

Important features of the afternoon meetings at the headquarters hotels are a symposium on "Cancer" on Tuesday and one on "Fractures and Other Traumas" on Wednesday. There will also be special panel discussions on "The Organization and Conduct of Cancer Clinics in Hospitals," and "Graduate Training in Surgery." Because of the wide interest in these subjects, it is expected that these meetings will attract a large attendance.

It is the aim of the Board of Regents and the local committee to provide a type of program that will enable each individual surgeon to learn of the newer developments in his field of practice. The subjects presented in the hospital clinics, panel discussions, and other scientific meetings will appeal to the surgical specialist as well as to the general surgeon. Each feature of the meeting has been carefully planned with this idea in mind. The detailed programs of these sessions will be found on the following pages.

### PRESIDENTIAL MEETING AND CONVOCATION

The always impressive processional of the officers, regents, and honorary guests will open the combined Presidential Meeting and Convocation to be held in Symphony Hall on Monday evening. Welcome will be extended to the assembly by the chairman of the local Committee on Arrangements, Dr. Leland S. McKittrick. Honorary guests will then be introduced, following which Dr. Evarts A. Graham, the retiring president, will deliver the presidential address. Other events on the program of this meeting will be the inaugural ceremony for the incoming officers, the presentation of the initiates for fellowship, and the awarding of the Medical Records Prize.

### ASSEMBLY OF INITIATES

On Monday afternoon there will be held the Assembly of Initiates. This meeting will be presided over by Dr. Evarts A. Graham, and Dr. Albert O. Singleton, Galveston, Texas, Vice-President of the College. Dr. Bowman C. Crowell and Dr. Malcolm T. MacEachern will discuss "The Program of the American College of Surgeons." Initiates will then recite the fellowship pledge and greetings will be extended by Dr. W. Edward Gallie, Toronto, President-Elect of the College. Closing remarks will be made by Dr. Irvin Abell, Chairman of the Board of Regents.

### FORUM ON FUNDAMENTAL SURGICAL PROBLEMS

As a new feature to be introduced at the Clinical Congress in Boston, the Board of Regents of the College has authorized the holding of a "Forum on Fundamental Surgical Problems." Plans for the

forum have been formulated by a committee under the chairmanship of Dr. Owen H. Wangensteen of Minneapolis. For many years, a great deal of clinical and experimental research has been done by younger surgeons working in medical schools and representative clinics and hospitals. Some of this work has resulted in outstanding contributions to medical and surgical knowledge. The results of much of this work are published but there has been limited opportunity for many of these younger surgeons to express themselves before larger medical groups. Recognizing this fact, it is felt that the American College of Surgeons should encourage the work of these men by providing a place on the program of the Clinical Congress for them. Therefore, the "Forum on Fundamental Surgical Problems" has been organized.

Sessions will be held on Tuesday, Wednesday, and Thursday mornings, with presentations of original and experimental work related to general surgery and the surgical specialties. There will be no prepared discussions but opportunity will be afforded those who attend to ask questions. Presentations will be limited to ten minutes each. Some of the best that is new in surgery will be presented and there is every indication that a live and active surgical forum in which younger men may participate will constitute one of the most important activities of the Congress in the future.

In formulating the preliminary plans for the forum, the committee in charge has been highly pleased with the response to this idea. Over 125 abstracts of subjects available for presentation have been submitted and from this material, the committee will select the most outstanding for the forum. The subjects, together with brief abstracts, will be published in the final general program of the Clinical Congress.

### OPHTHALMOLOGY AND OTOLARYNGOLOGY

An extensive program of scientific sessions and clinical demonstrations for ophthalmologists and otolaryngologists has been planned. Separate sessions scheduled for Tuesday and Thursday evenings will include papers and symposia on pertinent subjects in these fields. The leaders will direct the discussions in the meetings so as to cover many phases of a general subject in each of the specialties. Those attending will have an opportunity to express their viewpoints. On Wednesday evening, there will be a joint meeting of ophthalmologists and otolaryngologists with a symposium on "Neurosurgery as Related to the Eye and Ear." This type of program promises to attract wider interest than the presentation of formal papers.

Clinics in the Boston hospitals each morning and afternoon for the visiting ophthalmologists and otolaryngologists will demonstrate surgical work of great variety. On Tuesday, Wednesday, and Thursday mornings, in addition to the hospital program, there will be clinical conferences for each group of specialists at the headquarters hotel. These are being arranged so that the leader will briefly survey the field for discussion in a ten-minute period. The larger meeting will then be broken up into small groups limited to 20 and under separate leaders where there will be an opportunity for everyone to ask questions and participate in the discussion. Each visitor will select in advance the smaller group which he wishes to attend. In this manner, the general subject may be reviewed thoroughly and each visitor will benefit by the experiences and different ideas of his colleagues. The morning and evening meetings will be preceded by the showing of selected motion picture films on subjects related to ophthalmology and otolaryngology. The detailed programs of these special meetings appear in the following pages.

### NATIONAL AND REGIONAL FRACTURE COMMITTEES

The meeting of the National and Regional Fracture Committees, with Dr. Robert H. Kennedy, of New York, chairman of the National Committee, presiding, will be held on Thursday afternoon, when this assembly of surgeons will discuss the activities of the respective groups. Working in co-operation with the American Red Cross, other local organizations and public officials, these committees have exerted great influence in improving methods and facilities for the transportation of the injured. They have also made a concerted effort to improve the treatment of fractures in the hospitals of many communities. Pertinent problems will be discussed at the meeting of these committees.

### ANNUAL MEETING OF COMMITTEES

The annual meetings of the State and Provincial Judiciary, Credentials, and Executive Committees will be held on Wednesday morning. These committees have an important function to perform in the College. The Credentials Committees and the Committees on Applicants constitute one of the largest and most carefully deliberate accrediting bodies which exist in the medical profession. Through this organization the standards of fellowship are maintained and each fellow of the College has a definite responsibility in this work. All of the members of these committees are urged to attend this important meeting.

### ANNUAL MEETING OF FELLOWS

The annual meetings of the governors and fellows will be held on Thursday afternoon in the ballroom of the Copley-Plaza Hotel. The American College of Surgeons has been a potent force which has not only raised the professional and ethical standards of surgery, but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. Each individual fellow of the College has a part in this work and may extend its influence materially in his local community. Hospital standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works through continuous progress in applying the principles of the minimum standard. Other activities of the College have also received wide recognition by professional groups and the public as well, and together they present a vast educational program.

The annual meeting of the fellows affords officials of the College an opportunity to report on the work of the organization and to receive suggestions from those who have made possible the conduct of these activities. Every fellow of the College will want to attend this important meeting.

### MEDICAL MOTION PICTURES

Visual education plays an increasingly important rôle in the education of the surgeon. Therefore, an enlarged program of surgical motion pictures will be presented at headquarters which will include the latest available films on a variety of subjects. Schedules will be arranged so as not to conflict with the clinical program at hospitals or the scientific sessions, and will include both sound and silent, standard and color films, all of which have been approved by the Committee on Medical Motion Pictures of the College.

### SPECIAL MEETING OF BOSTON SURGICAL SOCIETY

On the evening of Friday, November 7, in Hancock Hall, which is located midway between the Statler and Copley-Plaza Hotels, the Boston Surgical Society will hold a special meeting to which all fellows of the College and other surgeons attending the Clinical Congress are invited to be present. The occasion of this special meeting of the society is the presentation of the Bigelow Medal to Dr. Allen O. Whipple, of New York, for his outstanding contributions to the advancement of surgery.

### HOSPITAL CONFERENCES

On Monday morning at 10:00 o'clock in the ballroom of the Copley-Plaza Hotel, the first session of the twenty-fourth annual Hospital Standardization Conference will open the Clinical Congress. The report of the 1941 Hospital Standardization survey—official announcement of the list of approved hospitals and hospitals approved for graduate training in surgery—will be made at this session. Dr. Evarts A. Graham, of St. Louis, president of the College, will preside. In addition there will be interesting discussions on the subjects of "Medical Preparedness," "The Preservation of Our Voluntary System of Hospitals," and "Maintaining the Control and Quality of the Professional Work in the Hospital." On Monday afternoon a panel discussion will deal with the timely subject of "Meeting the Problems of Rendering Adequate Care of the Patient and Maintaining Quality Standards of Service During the Present Period of Preparedness and National Emergency," with Dr. Nathaniel W. Faxon, of Boston, presiding.

The program for succeeding days, fully detailed in the following pages, will hold great interest for members of medical staffs, trustees, administrators, and other hospital personnel. Thus on Tuesday morning four panel discussions will deal with the essentials of efficiency of the hospital in (1) the Obstetrical Department, Dr. John R. Fraser, Montreal, presiding; (2) the Orthopedic Department, Dr. Henry H. Kessler, Newark, New Jersey, presiding; (3) Organization and Functioning of the Medical Staff, Dr. Joseph C. Doane, Philadelphia, presiding, and (4) the Department of Anesthesia, Dr. Ralph T. Knight, Minneapolis, presiding.

On Tuesday afternoon several pertinent subjects will be presented including, "The Organization of a Blood Transfusion Department in a General Hospital" by Drs. Leo M. Zimmerman and Sidney O. Levinson, Chicago. Following these papers a sound motion picture on the subject of "The Proper Use and Care of Hypodermic Needles" will be shown. Tuesday evening's session will be of particular interest to hospital trustees when the subject of the panel discussion will be "The Hospital Trustee in His Relationships and Responsibilities," led by Raymond P. Sloan, of New York.

On Wednesday morning, a joint session with the American Association of Medical Record Librarians will be held, with Dr. Robin C. Buerki, of Philadelphia, presiding. Wednesday evening will be given over to the showing of medical motion pictures for hospital personnel, including the film "White Battalions—Serving All Mankind."

Two important panel discussions will be held on Thursday morning; one on the "Essentials

Pertaining to an Efficient Department of Urology" will be led by Dr. George F. Cahill, New York, and the other "Essentials Pertaining to an Efficient Department of Ophthalmology and Otolaryngology" by Drs. Conrad Behrens and Marvin Jones, of New York. On Thursday afternoon, Drs. Robin C. Buerki, of Philadelphia, will lead a round-table conference on "Pertinent Problems Emanating from a Complete Survey of the Hospital Field." An ample opportunity will be given those present to submit questions which are not on the special program.

In preparing this portion of the program, organizations representing the specialty groups have been invited to participate. Special consideration will be given in this series of meetings to the important subject of graduate training in surgery. It is hoped that through this means the fellows of the College may become better acquainted with its program of hospital activities, which is aimed at improvement of the environment in which the surgeon is working—the hospital.

For Thursday afternoon a series of demonstrations in the local hospitals is being arranged. Those who are acquainted with Boston are fully aware of the inspiration furnished by the privilege of inspecting one of the country's greatest hospital centers. Those who have not had that privilege have a memorable experience in store.

At both the Clinical Congress and the sectional meetings of the College during recent years, the breakfast hospital conferences have been especially well attended. In Boston, such a conference will be held on Tuesday morning when there will be a "Forum on Fundamental Problems of Hospital Administration," sponsored by the American College of Hospital Administrators, in co-operation with the American College of Surgeons.

On Wednesday morning, the breakfast conference will be sponsored by the Boston Medical Record Librarians Association, in co-operation with the College, when there will be held a "Forum on Fundamental Considerations in the Art and Science of Medical Record Keeping." The Thursday morning breakfast conference will be devoted to hospital public relations. The plan is to allow each speaker ten minutes to present his subject, following which everyone will be called upon to give his reaction to the problem under discussion. Attendance at these meetings will necessarily be limited and arrangements will be made for advance registration.

One of the most important features of the hospital conference will be the daily consultation service from 4:30 to 6:00 p.m. This service affords an opportunity for everyone attending the meeting to consult with recognized leaders in the hospital field on any question or problem on which specific information is desired.

### PUBLICATION OF PROCEEDINGS

As in former years, the formal papers which are presented at the scientific sessions of the Congress will be presented in a special issue of the official journal of the College, "SURGERY, GYNECOLOGY, AND OBSTETRICS," published in February following the meeting. This issue is furnished without additional charge to all fellows, junior candidates, and others who register for the Congress as invited guests. The papers which are presented in connection with the Hospital Standardization Conference are published in subsequent issues of the *Bulletin* of the American College of Surgeons.

### ADVANCE REGISTRATION

The hospitals and medical schools of the Boston area afford accommodations for a large number of visiting surgeons, but to insure against overcrowding, attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based on a survey determining the available facilities in the participating hospitals and schools. It is expected, therefore, that surgeons who wish to attend the Congress will register in advance. A registration fee will be required in order to provide funds with which to meet expenses of the meeting. A formal receipt will be issued to each surgeon registering in advance which will be exchanged for a general admission card upon presentation at headquarters during the Congress. This card, which is not transferable, must accompany all requests for clinic tickets and be presented for admission to the scientific sessions.

A resolution adopted by the Board of Regents provides that the registration fee for fellows of the College and endorsed junior candidates shall be $5.00; that no fee for the 1941 Clinical Congress shall be required of initiates (class of 1941); that the fee for surgeons who are not fellows, attending as invited guests of the College, shall be $10.00.

As in previous years, admission to clinics and demonstrations in the hospitals and certain of the scientific meetings at headquarters will be controlled by means of tickets. This plan provides for the distribution of visiting surgeons at the various clinics and other meetings, and helps to insure against overcrowding. The number of

clinic tickets issued will be limited in each case to the capacity of the room in which the clinic is held. It should be pointed out that the clinical program as published in the following pages and also in the official program to be distributed at the Congress, obviously cannot include all of the detailed information regarding operative clinics and demonstrations scheduled for the various hospitals. The complete and final program will be provided from day to day, posted in the form of bulletins at headquarters each afternoon for the succeeding day, and published in the *Daily Clinical Bulletin* for distribution each morning. Visiting surgeons are urged to consult the bulletins posted at headquarters and the *Daily Clinical Bulletin* in selecting the clinics they wish to attend, and in making requisitions for clinic tickets. Co-operation in making the clinic ticket plan a success will be greatly appreciated.

### HEADQUARTERS AND TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Statler and Copley-Plaza Hotels where there are ample facilities for accommodating the Congress. All of the public rooms have been reserved for the exclusive use of the College during the five-day meeting. Registration for visiting surgeons and their ladies, the Technical Exhibition, executive offices of the College, and certain scientific sessions and medical motion picture exhibitions will be located in the Statler Hotel. Registration for those attending the hospital conference, exhibits of College activities, and the morning, afternoon, and evening hospital conferences will be located in the Copley-Plaza Hotel. The evening scientific sessions on Tuesday, Wednesday, and Thursday will also be held at the Copley-Plaza.

The Technical Exhibition, registration desk for attending surgeons, clinic ticket and information bureau will be located in the ballroom on the mezzanine floor of the Statler Hotel. Additional space for the exhibition will be provided in the Assembly Room and the mezzanine lounge adjacent to the ballroom. Leading manufacturers of surgical instruments and supplies, sutures, dressings, pharmaceuticals, operating room equipment of all kinds, and publishers of medical books will be represented in the exhibition. It will provide an opportunity for surgeons and hospital visitors to carefully inspect the finest modern products of all those industries which are helping to improve the service of hospitals and surgeons.

### COMMITTEE ON ARRANGEMENTS

Leland S. McKittrick, Chairman
Richard H. Sweet, Secretary
Arthur W. Allen
Edward D. Churchill
Howard M. Clute
E. Granville Crabtree
Elliott C. Cutler
Frederick C. Irving
William E. Ladd
Frank H. Lahey
Donald Munro
Charles G. Mixter
Frank R. Ober
Robert B. Osgood
Frank A. Pemberton
George L. Tobey, Jr.
Frederick H. Verhoeff
Irving J. Walker
Shields Warren

### RAILROAD FARES

As no special rates have been authorized by the railroads of the United States or Canada for the 1941 Clinical Congress in Boston, in accordance with the policy adopted by the railroads, no certificates will be required. However, round-trip tickets to Boston, sold at less than double the regular one-way fare, will be available from points in the United States and Canada. Return limit privileges of such round-trip tickets are liberal but are not uniform in all sections of the country. In most instances the return limit is 30 days or more. Surgeons planning to attend the Congress should consult local ticket agents several days in advance of the date of the meeting for complete information as to fares, routes, stopover privileges, etc.

### BOSTON HOTELS AND THEIR RATES

In addition to the headquarters hotels, the Statler and Copley-Plaza, there are a number of first-class hotels within a short distance of headquarters. These will provide ample facilities at reasonable rates. It is suggested that reservations for hotel accommodations be made well in advance of the meeting. The following hotels are recommended by the committee:

| | Minimum Rates with Bath | |
|---|---|---|
| | Single | Double |
| Bellevue, 21 Beacon Street | $3.00 | $4.50 |
| Bradford, 275 Tremont Street | 3.00 | 4.50 |
| Brunswick, 520 Boylston Street | 3.00 | 4.00 |
| Buckminster, 645 Beacon Street | 2.50 | 4.00 |
| Copley-Plaza, 138 St. James Avenue | 4.00 | 6.00 |
| Copley Square, 47 Huntington Avenue | 2.75 | 4.00 |
| Kenmore, 490 Commonwealth Avenue | 3.50 | 5.00 |
| Lenox, Exeter Street | 3.00 | 3.50 |
| Lincolnshire, 20 Charles Street | 3.00 | 5.00 |
| Parker House, 60 School Street | 3.50 | 5.00 |
| Ritz-Carlton, 15 Arlington Street | 5.00 | 8.00 |
| Sheraton, 91 Bay State Road | 3.00 | 5.00 |
| Somerset, 400 Commonwealth Avenue | 3.50 | 6.00 |
| Statler, Park Square | 3.50 | 5.00 |
| Touraine, 62 Boylston Street | 3.50 | 5.00 |
| Vendome, 160 Commonwealth Avenue | 3.00 | 4.00 |
| Westminster, 124 St. James Avenue | 2.50 | 4.00 |

## HOSPITALS AND REPRESENTATIVES

Beth Israel Hospital—Jacob Fine
Beverly Hospital—Richard E. Alt
Evangeline Booth Maternity Hospital—William J. McDonald
Boston City Hospital—Otto J. Hermann
Boston Lying-in Hospital—Frederick C. Irving
Peter Bent Brigham Hospital—Elliott C. Cutler
Robert Breck Brigham Hospital—John G. Kuhns
Carney Hospital—A. M. Fraser
Children's Hospital—Thomas H. Lanman
Faulkner Hospital—E. L. Young
Free Hospital for Women—Frank A. Pemberton
Collis P. Huntington Memorial Hospital—C. C. Simmons
Lakeville State Sanitorium—George W. VanGorder
Malden Hospital—E. J. Reynolds
Massachusetts Eye and Ear Infirmary—F. H. Verhoeff
Massachusetts General Hospital—Arthur W. Allen
Massachusetts Memorial Hospitals—Frank E. Barton
New England Baptist Hospital—N. W. Swinton
New England Deaconess Hospital—B. P. Colcock
New England Hospital for Women and Children—L. D. Adams
New England Medical Center—Samuel H. Proger
Newton Hospital—E. D. Leonard
Palmer Memorial Hospital—L. S. McKittrick
Pondville Hospital—E. M. Daland
St. Elizabeth's Hospital—Joseph Stanton
Salem Hospital—Walter G. Phippen
United States Marine Hospital—R. L. Waugh
United States Naval Hospital—J. J. A. McMullin

# PROGRAMS FOR EVENING SESSIONS

*Presidential Meeting and Convocation—Monday, 8:00 p.m.—Symphony Hall*

EVARTS A. GRAHAM, M.D., St. Louis; President, American College of Surgeons, Presiding.
Processional—Officers, Regents, and Honorary Guests.
Invocation.
Address of Welcome. LELAND S. MCKITTRICK, M.D., Boston; Chairman, Committee on Arrangements.
Introduction of Foreign Guests. ARTHUR W. ALLEN, M.D., Boston; Vice Chairman, Board of Regents.
Address of Retiring President: American Surgery in a Changing World. EVARTS A. GRAHAM, M.D., St. Louis.
Inauguration of Officers:
President: W. EDWARD GALLIE, M.D., Toronto.
First Vice President: CLARENCE G. TOLAND, M.D., Los Angeles.
Second Vice President: ALBERT C. FURSTENBERG, M.D., Ann Arbor.
Presentation of Initiates for Fellowship. IRVIN ABELL, M.D., Louisville; Chairman, Board of Regents.
Conferring of Fellowships by the President. W. EDWARD GALLIE, M.D., Toronto.
Conferring of Honorary Fellowships. The President.
Medical Records Prize Award.

*Tuesday, 8:00 p.m.—Ballroom, Copley-Plaza Hotel*

Annual Oration on Surgery: Some Lessons Learned in the Great War. W. EDWARD GALLIE, M.D., Toronto.
Use of Female Sex Hormones in Clinical Practice. EDWIN C. HAMBLEN, M.D., Durham, N. C.
The Prevention and Treatment of Tetanus. WARFIELD M. FIROR, M.D., Baltimore.
The Care of the Slightly Wounded. WILLIAM DARRACH, M.D., New York.

*Wednesday, 8:00 p.m.—Ballroom, Copley-Plaza Hotel*

Subject to be announced. GORDON GORDON-TAYLOR, O.B.E., F.R.C.S. (Eng.), London, England.
Endocrine Aspects of Chronic Cystic Mastitis. HOWARD C. TAYLOR, JR., M.D., New York.
Penetrating Wounds of the Heart and Pericardium. R. ARNOLD GRISWOLD, M.D., and C. H. MAGUIRE, M.D., Louisville.
Oration on Fractures and Other Traumas: The General Surgeon's Approach to Problems Presented by Fractures and Other Traumas. WALTER ESTELL LEE, M.D., Philadelphia.

*Thursday, 8:00 p.m.—Ballroom, Copley-Plaza Hotel*

Subject to be announced. PROFESSOR PABLO LUIS MIRIZZI, M.D., Cordoba, Argentina.
Carcinoma of the Stomach (Diagnostic Methods and Therapy). HOWARD K. GRAY, M.D., Rochester, Minn.
Non-penetrating Wounds of the Abdomen. W. L. ESTES, JR., M.D., Bethlehem, Pa.
Adrenal Cortical Tumors; the Types of Non-hormonal and Hormonal Tumors. GEORGE F. CAHILL, M.D., New York.
Evaluation of Blood and Blood Substitutes. ALFRED BLALOCK, M.D., Nashville.

# PROGRAMS FOR EVENING SESSIONS

## OPHTHALMOLOGY

*Tuesday, 8:00 p.m.—Copley-Plaza Hotel*

Symposium: Surgery of Heterophoria and Heterotropia.
Preoperative Diagnosis and Treatment. JAMES W. WHITE, M.D., New York.
Recent Advances in the Surgery of Heterotropia. PROFESSOR MOACYR EYCK ALVARO, M.D., Sao Paulo, Brazil.
Surgical Management of Heterophoria. DERRICK T. VAIL, JR., M.D., Cincinnati.
Results of Operation and Causes of Failure. WILLIAM THORNWALL DAVIS, M.D., Washington.

*Thursday, 8:00 p.m.—Copley-Plaza Hotel*

Symposium: Principles of Ophthalmic Surgery.
Surgical Anatomy of the Eye. F. BRUCE FRALICK, M.D., Ann Arbor.
Refinements of General Surgical Technique as Applied to Ophthalmology. CONRAD BERENS, M.D., New York.
Management of Surgical Complications. THOMAS D. ALLEN, M.D., Chicago.

## OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY

*Wednesday, 8:00 p.m.—Copley-Plaza Hotel*

Symposium: Neurological Surgery as Related to the Eye and Ear.
Intracranial Infections and Their Spread from the Ear and from the Sinuses. ALBERT C. FURSTENBERG, M.D., Ann Arbor, Mich.
Retrobulbar Neuritis in Relation to Sinus Disease. JAMES B. COSTEN, M.D., St. Louis.
Tumors of the Acoustic Nerve. BYRON STOOKEY, M.D., New York.
Major Surgery of the Orbit. HOWARD C. NAFFZIGER, M.D., San Francisco.
Interpretation of Perimetric Fields of Vision as Manifested in Intracranial Disease. WALTER I. LILLIE, M.D., Philadelphia.

## OTORHINOLARYNGOLOGY

*Tuesday, 8:00 p.m.—Copley-Plaza Hotel*

Mastoid Diseases in the Light of Chemotherapy. JAMES H. MAXWELL, M.D., Ann Arbor, Mich.
Refinements in the Technique of Laryngectomy. WAITMAN F. ZINN, M.D., Baltimore.
The Otology of Craniocerebral Injuries. WILLIAM E. GROVE, M.D., Milwaukee, Wis.

*Thursday, 8:00 p.m.—Copley-Plaza Hotel*

Symposium: The Salivary Gland.
Benign Tumors. ALBERT O. SINGLETON, M.D., Galveston, Texas
Malignant Tumors. LEROY A. SCHALL, M.D., Boston.
Infections. AUGUST L. BECK, M.D., New Rochelle, N. Y.

## PROGRAMS FOR AFTERNOON SESSIONS

### SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

*Wednesday, 2:00 p.m.—Copley-Plaza Hotel*

ROBERT H. KENNEDY, M.D., New York; Chairman, Committee on Fractures and Other Traumas, Presiding.

Gunshot Wounds of the Abdomen. AMBROSE H. STORCK, M.D., New Orleans.

A Critical Survey of Ten Years' Experience with Fractures of the Neck of the Femur. MATHER CLEVELAND, M.D., New York.

Factors in the Choice of Material for Bone Plates and Screws. CHARLES S. VENABLE, M.D., San Antonio, Texas.

Treatment of Burns. GROVER C. PENBERTHY, M.D., Detroit.

Results in Cases of Compound Fractures Followed by Osteomyelitis. STANTON K. LIVINGSTON, M.D., Veterans Administration Facility, White River Junction, Vermont.

## GROUP CLINICAL CONFERENCES

### OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY

*Tuesday, 11:00 a.m.*

Surgery of Squint. JOHN H. DUNNINGTON, M.D., New York, Presiding.

Treatment of Sinus Disease in Children. SAMUEL SALINGER, M.D., Chicago, Presiding.

*Wednesday, 11:00 a.m.*

Surgery of the Tear Passages. WALTER S. ATKINSON, M.D., Watertown, N. Y., Presiding.

Indications for Surgery of the Nose and Throat in Diabetics. WESTLEY M. HUNT, M.D., New York, Presiding.

*Thursday, 11:00 a.m.*

Surgery of the Orbit. ALGERNON B. REESE, M.D., New York, Presiding.

Surgical Treatment of Deafness. SAMUEL J. KOPETZKY, M.D., New York, Presiding.

## PANEL DISCUSSIONS

Injuries to the Spine. ERIC OLDBERG, M.D., Chicago, Presiding.
Collaborators: FREDERICK A. JOSTES, M.D., St. Louis; HOWARD C. NAFFZIGER, M.D., San Francisco; J. E. M. THOMSON, M.D., Lincoln, Neb.

Diseases of the Esophagus. ALTON OCHSNER, M.D., New Orleans, Presiding.
Collaborators: CARL EGGERS, M.D., New York; FRANK H. LAHEY, M.D., Boston; GABRIEL TUCKER, M.D., Philadelphia.

Thyroid Disease Associated with Congestive Failure. WILLIAM B. PARSONS, M.D., New York, Presiding.
Collaborators: RICHARD B. CATTELL, M.D., Boston; ROBERT S. DINSMORE, M.D., Cleveland; MERRILL N. FOOTE, M.D., Brooklyn.

Postoperative Pulmonary Complications. LEO ELOESSER, M.D., San Francisco, Presiding.
Collaborator: HENRY K. BEECHER, M.D., Boston.

Lung Surgery. STUART W. HARRINGTON, M.D., Rochester, Minn., Presiding.
Collaborators: RICHARD H. MEADE, JR., M.D., Philadelphia; HAROLD NEUHOF, M.D., New York; WILLIAM F. RIENHOFF, JR., M.D., Baltimore.

Gastric Ulcer. URBAN MAES, M.D., New Orleans, Presiding.
Collaborators: RALPH COLP, M.D., New York; VERNE C. HUNT, M.D., Los Angeles; GEORGE P. MULLER, M.D., Philadelphia.

Experience with the Miller-Abbott Tube. ALLEN O. WHIPPLE, M.D., New York, Presiding.
Collaborators: WILLIAM O. ABBOTT, M.D., Philadelphia; CHARLES G. JOHNSTON, M.D., Detroit; ANGUS MCLACHLIN, M.D., Toronto.

Optimum Time for Operation with Special Consideration of Acute Gallbladder Attacks. HENRY F. GRAHAM, M.D., Brooklyn, Presiding.
Collaborators: FRANK GLENN, M.D., New York; CHARLES GORDON HEYD, M.D., New York; E. MACDONALD STANTON, M.D., Schenectady, N. Y.

Penetrating Abdominal Wounds Caused by Trauma. ARTHUR M. SHIPLEY, M.D., Baltimore, Presiding.
Collaborators: E. CLARENCE MOORE, M.D., Los Angeles; ELKIN L. RIPPY, M.D., Nashville; ALBERT O. Singleton, M.D., Galveston.

Disruption of Abdominal Wounds. FRANK GLENN, M.D., New York, Presiding.
Collaborators: LAWRENCE S. FALLIS, M.D., Detroit; L. KRAEER FERGUSON, M.D., Philadelphia; HILGER P. JENKINS, M.D., Chicago.

The Sulfonamide Group in Abdominal Surgery. FREDERICK A. COLLER, M.D., Ann Arbor, Presiding.
Collaborators: PERRIN H. LONG, M.D., Baltimore; I. S. RAVDIN, M.D., Philadelphia; JAMES E. THOMPSON, JR., M.D., New York.

Intestinal Obstruction in Children. WILLIAM E. LADD, M.D., Boston, Presiding.
Collaborators: WILLIS D. GATCH, M.D., Indianapolis; GEORGE B. PACKARD, M.D., Denver; GROVER C. PENBERTHY, M.D., Detroit.

The Management of the Perforated Appendix, Early and Late. HENRY K. RANSOM, M.D., Ann Arbor, Mich., Presiding.
Collaborators: J. MONTGOMERY DEAVER, M.D., Philadelphia, CLARENCE E. GARDNER, M.D., Durham, N. C.; E. ERIC LARSON, M.D., Los Angeles.

Surgical Diseases of the Colon. CHARLES W. MAYO, M.D., Rochester, Minn., Presiding.
Collaborators: THOMAS G. ORR, M.D., Kansas City, Mo.; HOWARD PATTERSON, M.D., New York; J. WILLIAM THOMPSON, M.D., St. Louis.

Management of Abortion. CONRAD G. COLLINS, M.D., New Orleans, Presiding.
Collaborators: RALPH E. CAMPBELL, M.D., Madison, Wis.; JOHN R. FRASER, M.D., Montreal; H. CLOSE HESSELTINE, M.D., Chicago.

Treatment of Chronic Cervicitis. GEORGE H. GARDNER, M.D., Chicago, Presiding.
Collaborators: JOHN C. BURCH, M.D., Nashville; J. MASON HUNDLEY, JR., M.D., Baltimore; JOE V. MEIGS, M.D., Boston.

Management of Calcium Urolithiasis. NORMAN W. ROOME, M.D., London, Ont., Presiding.
Collaborators: HENRY O. MERTZ, M.D., Indianapolis; JOHN K. ORMOND, M.D., Detroit; A. J. SCHOLL, M.D., Los Angeles.

Traumas to the Head. FRANCIS C. GRANT, M.D., Philadelphia, Presiding.
Collaborators: CHARLES BAGLEY, JR., M.D., Baltimore; COBB PILCHER, M.D., Nashville; JAMES C. WHITE, M.D., Boston.

Fractures of the Facial Bones. LLOYD NOLAND, M.D., Fairfield, Ala., Presiding.
Collaborators: ROBERT H. IVY, M.D., Philadelphia; CARL W. WALDRON, M.D., Minneapolis· Charles, H. WILSON, M.D., New Orleans.

Treatment of Acute Suppurative Tenosynovitis of the Fingers, Palm, and Forearm. HUGH AUCHINCLOSS, M.D., New York, Presiding.

Collaborators: WILLIAM E. BROWNE, M.D., Boston; J. H. COUCH, M.D., Toronto; JAMES M. WINFIELD, M.D., Detroit.

The Treatment of the Wound in Compound Fractures. CLAY RAY MURRAY, M.D., New York, Presiding.

Collaborators: R. ARNOLD GRISWOLD, M.D., Louisville; J. ALBERT KEY, M.D., St. Louis; HENRY C. MARBLE, M.D., Boston.

Principles Involved in Hip Joint Arthroplasty. M. N. SMITH-PETERSEN, M.D., Boston., Presiding.

Collaborators: CARL E. BADGLEY, M.D., Ann Arbor, Mich.; GEORGE E. BENNETT, M.D., Baltimore; PHILIP D. WILSON, M.D., New York.

Developments in the Field of Poliomyelitis Research. EDWARD L. COMPERE, M.D., Chicago, Presiding.

Collaborators: FREMONT A. CHANDLER, M.D., Chicago; CHARLES L. LOWMAN, M.D., Los Angeles; OSCAR L. MILLER, M.D., Charlotte, N.C.

Advances in Skin Grafting. EARL C. PADGETT, M.D., Kansas City, Mo., Presiding.

Collaborators: JAMES BARRETT BROWN, M.D., St. Louis: MICHAEL L. MASON, M.D., Chicago; HANS MAY, M.D., Philadelphia.

Treatment of Contaminated and Infected Wounds FRASER B. GURD, M.D., Montreal, Presiding.

Collaborators: JOSEPH E. HAMILTON, M.D., Louisville; MICHAEL L. MASON, M.D., Chicago· FREDERICK S. WETHERELL, M.D., Syracuse, N.Y.

Chemotherapy in Wound Healing. EDWARD L. HOWES, M.D., New York, Presiding.

Collaborators: HILGER P. JENKINS, M.D., Chicago; FRANK L. MELENEY, M.D., New York; J. ROSS VEAL, M.D., Washington.

Continuous Spinal Anesthesia. WILLIAM T. LEMMON, M.D., Philadelphia, Presiding.

Collaborators: H. H. BRADSHAW, M.D., Winston-Salem, N. C.; RALPH T. KNIGHT, M.D., Minneapolis; EDWARD B. TUOHY, M.D., Rochester, Minn.

Anesthesia in War. KENNETH C. MCCARTHY, M.D., Toledo, Presiding.

Anesthesia for Surgical Procedures within the Upper Abdomen. RALPH M. TOVELL, M.D., Hartford, Conn., Presiding.

Collaborators: HENRY K. BEECHER, M.D., Boston; HOWARD K. GRAY, M.D., Rochester, Minn.; HENRY S. RUTH, M.D., Merion, Pa.

Transfusion and Blood Substitutes, Especially Plasma, in the Prevention and Treatment of Shock. ROY D. MCCLURE, M.D., Detroit, Presiding.

Collaborators: NORMAN E. FREEMAN, M.D., Philadelphia; JOHN SCUDDER, M.D., New York; OWEN H. WANGENSTEEN, M.D., Minneapolis.

Contributions to Medical Progress through Postmortem Examinations. ALAN R. MORITZ, M.D., Boston, Presiding.

Collaborators: A. D. GETTLER, New York; HARRISON S. MARTLAND, M.D., Newark, N.J.

Vitamins in Surgery. WARREN H. COLE, M.D., Chicago, Presiding.

Collaborators: EMILE HOLMAN, M.D., San Francisco; WALTER ESTELL LEE, M.D., Philadelphia; CHARLES C. LUND, M.D., Boston.

Graduate Training in Surgery in Hospitals. ROBIN C. BUERKI, M.D., Philadelphia, Presiding.

Collaborators: DAVID H. BALLON, M.D., Montreal; GEORGE F. CAHILL, M.D., New York; EDWARD D. CHURCHILL, M.D., Boston; JOHN R. FRASER, M.D., Montreal; W. EDWARD GALLIE, M.D., Toronto; HARRY S. GRADLE, M.D., Chicago; DALLAS B. PHEMISTER, M.D., Chicago; STANLEY J SEEGER, M.D., Milwaukee, Wis.; PHILIP D. WILSON, M.D., New York.

# ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

*Monday, 10:00 a.m.—Copley-Plaza Hotel*

EVARTS A. GRAHAM, M.D., St. Louis; President, American College of Surgeons, presiding.

Address of the President—The Hospital Program of the American College of Surgeons.

Report of the 1941 Hospital Standardization Survey—Official Announcement of the List of Approved Hospitals. IRVIN ABELL, M.D., Louisville; Chairman, Board of Regents, and EARLE W. WILLIAMSON, M.D., Chicago; Assistant Director, American College of Surgeons.

Report on Graduate Training in Surgery. DALLAS B. PHEMISTER, M.D., Chicago; Chairman, Committee on Graduate Training in Surgery, and HAROLD EARNHEART, M.D., Chicago; Assistant Director, American College of Surgeons.

Important Legislative, Preparedness and Emergency Problems Now Facing Hospitals. BERT W. CALDWELL, M.D., Chicago; Executive Secretary, American Hospital Association.

The Preservation of Our Voluntary System of Hospitals. REV. ALPHONSE W. SCHWITALLA, S. J., St. Louis; President, Catholic Hospital Association.

National Events—Their Effect on Personnel Relations. FRANK J. WALTER, Denver.

The Responsibility of the Medical Staff in Maintaining Control and Quality of the Professional Work in the Hospital. MERRILL N. FOOTE, M.D., Brooklyn.

The Preparedness Program for Hospitals. JAMES A. HAMILTON, New Haven, Conn.

*Monday, 2:00 p.m.—Copley-Plaza Hotel*

Panel Round Table Conference: Meeting the Problems of Rendering Adequate Care of the Patient and Maintaining Quality Standards of Service During the Present Period of Preparedness and National Emergency. NATHANIEL W. FAXON, M.D., Boston, presiding.

Discussion from the viewpoint of personnel:

Medical Staff. NORBERT A. WILHELM, M.D., Boston.

Resident Medical Staff. CLAUDE W. MUNGER, M.D., New York.

Nursing Staff. SALLY JOHNSON, R.N., Boston.

Discussion from the standpoint of medical, surgical and hospital equipment, instruments and supplies:

Scientific Equipment and Instruments. D. H. PALMER, New York.

Surgical Dressings, Rubber Goods and Other Supplies. L. M. ARROWSMITH, Brooklyn.

Surgical Ligatures, Pharmaceuticals and Chemicals. EVERETT W. JONES, Albany, N. Y.

Discussion from the standpoint of operating costs:

Foodstuffs, Supplies of All Kinds, Commodities, etc. MIRIAM CURTIS, R.N., Syracuse, N. Y.

Salaries and Wages. ABRAHAM OSEROFF, Pittsburgh.

Supplementary Revenue: Subsidies, Gifts, Donations, Endowments, etc. OLIVER H. BARTINE, Bridgeport, Conn.

General Discussion. Other related subjects may be presented.

*Monday, 4:30 p.m.—Copley-Plaza Hotel*

Consultation Service. Opportunity will be afforded everyone attending the Hospital Standardization Conference to consult with recognized leaders in the hospital field, on any question or problem on which specific information is desired. A consultation service will be available at the time and place specified in the program, by means of pre-arranged information stations, on six different phases of hospital service daily. This service will be provided by leaders in the various fields of hospital administration and management.

Administrative Practices and Policies. EDGAR C. HAYHOW, Paterson, N. J.

Anesthesia Service. E. B. TUOHY, M.D., Rochester, Minn.

Clinical Laboratory and Pathological Service. WILMAR M. ALLEN, M.D., Hartford, Conn.

Control of Major Surgery in the Hospital. E. MACDONALD STANTON, M.D., Schenectady, N. Y.

Food Service in the Hospital—Diet Therapy. GENEVA MARBLE, Boston.

Hospital Preparedness in the Defense Program. OLIVER G. PRATT, Salem, Mass.

*Tuesday, 7:45 a.m.—Copley-Plaza Hotel*

Breakfast Conference, Sponsored by the American College of Hospital Administrators in co-operation with the American College of Surgeons: Forum on Fundamental Problems of Hospital Administration. SCOTT WHITCHER, New Bedford, Mass., presiding.

Discussion from the following aspects:

Relation of Personal Qualities and Attitudes to Successful Hospital Administration. G. HARVEY AGNEW, M.D., Toronto, Ont.

Critical Analysis of Present Methods of Training for Hospital Administration. E. M. BLUESTONE, M.D., New York.

General Discussion. Opened by GERHARD HARTMAN, Chicago.

*Tuesday, 9:30 a.m.—Copley-Plaza Hotel*

Panel Discussion: Essentials Pertaining to an Efficient Obstetrical Department in the Hospital. JOHN R. FRASER, M.D., Montreal, leader. Collaborators: JOSEPH L. BAER, M.D., Chicago; CLARA M. KONRAD, R.N., Jersey City; JAMES R. MILLER, M.D., Hartford.

Topics for discussion: Accommodations, facilities and equipment of a modern obstetrical department. Supervision and management of the obstetrical department. Personnel—resident, medical and nursing staffs. Qualifications of the medical staff in the practice of obstetrics within the hospital. Control of the clinical work. Essentials of a complete obstetrical record. Control of infections and complications. Periodic analytical summaries of end results. Care of the newborn. Graduate training in obstetrics.

Panel Discussion: Essentials Pertaining to an Efficient Department of Orthopedic Surgery in the Hospital. HENRY H. KESSLER, M.D., Newark, N. J., leader. Collaborators: FRANK D. DICKSON, M.D., Kansas City, Mo.; FREMONT A. CHANDLER, M.D., Chicago.

Topics for discussion: Accommodations, facilities and equipment of a department of orthopedic surgery in a hospital. Supervision and management of the department of orthopedic surgery. Personnel—resident, medical and nursing staffs. Qualifications of the medical staff to do orthopedic surgery. Control of the clinical work of the department of orthopedic surgery. Essential contents of the medical record in orthopedic surgery. Review and analysis of the clinical work of the department of orthopedic surgery. Splint and brace shop. Follow-up and study of end results. Graduate training in orthopedic surgery.

*Tuesday, 11:00 a.m.—Copley-Plaza Hotel*

Panel Discussion: Organization and Functioning of the Medical Staff. JOSEPH C. DOANE, M.D., Philadelphia, leader. Collaborators: STANLEY J. SEEGER, M.D., Milwaukee; JULIUS H. COMROE, York, Pa.; CHARLES B. PUESTOW, M.D., Chicago; ALLAN CRAIG, M.D., Bangor, Maine.

Topics for discussion: Standards of qualifications in making appointments to the medical staff. Procedure in making appointments to the medical staff. Legal responsibility of the hospital in respect to the professional work of the hospital. Supervision and control of major surgery and major obstetrics. Basic considerations in making promotions on the medical staff of the hospital. Essential features in conducting the medical staff conference. Maintaining adequate medical records. Increasing the number of consultations in hospital practice. Supervision of the work of the resident medical staff. Responsibility of the senior members of the medical staff in instructing junior members.

Panel Discussion: Essentials Pertaining to an Efficient Department of Anesthesia in the Hospital. RALPH T. KNIGHT, M.D., Minneapolis, leader. Collaborators: RALPH M. TOVELL, M.D., Hartford; HENRY RUTH, M.D., Merion, Pa.; HENRY M. POLLOCK, M.D., Boston.

Topics for discussion: Accommodations, facilities and equipment of the department of anesthesia in the hospital. Supervision and management of the department of anesthesia. Essential qualifications for the efficient administration of anesthesia. Anesthesia records to be maintained. A critical analysis of newer types of anesthetics and methods of administration. Hazards associated with the administration of anesthetics. Training of interns and residents in the administration of anesthetics. Follow-up and study of end results in the administration of anesthetics. Handling of emergency anesthetics. Graduate training in anesthesiology.

*Tuesday, 2:00 p.m.—Copley-Plaza Hotel*

ALBERT G. ENGELBACH, M.D., Cambridge, Mass., presiding.

The Organization of a Blood Transfusion Department in a General Hospital. LEO M. ZIMMERMAN, M.D., and SIDNEY O. LEVINSON, M.D., Chicago.

Organization and Use of the Medical Library by the Medical Staff and Personnel of the Hospital. L. MARGUERITTE PRIME, Chicago.

A Successful Plan in Handling the Personnel Health Service in the Hospital. JOSEPH G. NORBY, Milwaukee.

The Control and Assignment of Duties of Non-Professional Workers in the Hospital. FRANCES C. LADD, R.N., Boston.

*Tuesday, 4:30 p.m.—Copley-Plaza Hotel*

Consultation Service:

Internships and Residencies. M. G. WESTMORELAND, M.D., Chicago.

Medical Records. EDNA K. HUFFMAN, R.R.L., Chicago.

Medical Social Service. MABEL WILSON, Boston.

Medical Staff Problems. PAUL S. FERGUSON, M.D., Chicago.

Sterilization of Surgical Dressings, Instruments, Rubber Goods, Supplies, etc. SAMUEL R. D. HEWITT, M.D., St. John, New Brunswick.

*Tuesday, 8:00 p.m.—Copley-Plaza Hotel*

Panel Discussion: The Hospital Trustee in his Relationships and Responsibilities. RAYMOND P. SLOAN, New York, leader. Collaborators: FRANK O. ROBSON, Southbridge, Mass.; JOHN MACGREGOR, Boston; SAMUEL STEWART, Lewiston, Maine; CHARLES F. WILINSKY, M.D., Boston.

Topics for discussion: Qualifications of the ideal hospital trustee. Acquiring essential knowledge concerning hospital administration. Relationship of the hospital trustee to (a) the administration; (b) the medical staff. The problem of the hospital trustee in selecting a hospital administrator. The trustee's responsibility in the increasing financial responsibility of the hospital. The hospital trustee's approach to problems with possible legal or liability significance. Meeting the responsibility of the present demands on hospitals incident to the preparedness program. Preparation and conduct of the monthly meeting of the board of trustees. Monthly and annual reports. The trustee's participation in public relations of the hospital.

Motion picture preview: White Battalions—Serving All Mankind.

*Wednesday, 7:45 a.m.—Copley-Plaza Hotel*

Breakfast Conference, Sponsored by the Boston Medical Record Librarians Association in co-operation with the American College of Surgeons: Forum on Fundamental Considerations in the Art and Science of Medical Record Keeping. W. FRANKLIN WOOD, M.D., Waverley, Mass., presiding.

Discussion from the following aspects:

A Critical Analysis of the Present Ways and Means of Training Medical Record Librarians. SISTER M. LORETTA, R.R.L., Duluth, Minn.

The Place of the Medical Record Librarian in the Hospital Organization. MARGARET DUBOIS, M.D., Chicago.

What the Medical Record Librarian Can Contribute towards Making a Success of Her Career. MARGARET TAYLOR, R.R.L., Rochester, N. Y.

*Wednesday, 9:30 a.m.—Copley-Plaza Hotel*

Joint Conference with American Association of Medical Record Librarians. ROBIN C. BUERKI, M.D., Philadelphia, presiding.

Our Challenge—Good Medical Records in Our Hospitals. ANNA C. SCHULZE, R.R.L., Philadelphia.

The Role of the Record Librarian in the Changing World. SISTER MARY SERVATIA, R.R.L., St. Louis.

The Preparation of Medical Statistics and Special Studies for the Medical Staff. MARY M. NEWTON, R.R.L., Evanston, Ill.

An Analysis of the Present Problems of Securing Adequate Medical Records in Hospitals, and Their Practical Solution. PAUL B. FERGUSON, M.D., Chicago.

Medical Photography as an Aid to More Comprehensive Medical Records. C. G. BROWNELL, Rochester, N. Y.

Organization and System in Handling Tumor Clinic Records. FLORENCE G. BABCOCK, R.R.L., Ann Arbor, Mich.

The Introduction and Orientation of the Intern to Medical Record Keeping in the Hospital. MARSHALL DAVISON, M.D., Chicago.

Round Table Conference—Discussion of the following topics: The filming of medical records. The present status of the standard nomenclature. Recording of infections in the medical record. The place of the medical secretary in securing medical records. Floor supervision of current medical records. The use of the dictaphone in securing medical records. Assisting the members of the medical staff by providing statistical and other information for scientific presentations. Co-operation between the medical record department and the medical library. Ideal setup for the medical record room. Postgraduate courses for medical record librarians.

*Wednesday, 2:30 p.m.—Local Hospitals*

Hospital Demonstrations: Administrative, technical, and hospital standardization procedures.

*Wednesday, 4:30 p.m.—Copley-Plaza Hotel*

Consultation Service:

Nursing Service. MARY SHEPARD, Cambridge, Mass.

Obstetrical Department Management. FRANCES YOUNG, Boston.

Occupational Therapy. LUCY G. MORSE, O.T.R., Boston.

Outpatient Department Problems. A. G. ENGELBACH, M.D., and SAMUEL THORNDIKE, M.D., Cambridge, Mass.

Personnel Management and Personnel Relations. FRANK WALTER, Denver, Colo.

Public Relations. JOSEPH P. LEONE, M.D., Quincy, Mass.

*Wednesday, 8:00 p.m.—Copley-Plaza Hotel*

Motion Pictures for Hospital Personnel: How We Hear; How We See (sound); Foods and Nutrition (sound); Endocrine Glands (sound); Heart and Circulation (sound); A New Day (Deals with Pneumonia) (sound); Goodbye, Mr. Germ; Choose to Live (A Woman's Encounter with Cancer); Let My People Live (sound); Proper Care and Use of Hypodermic Needles; White Battalions—Serving All Mankind.

*Thursday, 9:30 a.m.—Copley-Plaza Hotel*

Panel Discussion: Essentials Pertaining to an Efficient Department of Urology in the Hospital. GEORGE F. CAHILL, M.D., New York, leader. Collaborators: LEO P. DOLAN, M.D., Toledo; GILBERT J. THOMAS, M.D., Minneapolis.

Topics for discussion: Accommodations, facilities and equipment of a department of urology in the hospital. Supervision and management of the department of urology. Personnel management—resident, medical and nursing staffs. Qualifications of the medical staff to do urology. Control of the clinical work of the department of urology. Essentials of the medical record in urology. Regular periodic review and analysis of the clinical work in urology. Follow-up and study of end results. Graduate training in urologic surgery.

*Thursday, 11:00 a.m.—Copley-Plaza Hotel*

Panel Discussion: Essentials Pertaining to an Efficient Department of Ophthalmology and Otolaryngology in the Hospital. CONRAD BEHRENS, M.D., and MARVIN JONES, M.D., New York, leaders. Collaborator: LAWRENCE T. POST, M.D., St. Louis.

Topics for discussion: Accommodations, facilities and equipment of the department of ophthalmology and otolaryngology. Supervision and management of the department of ophthalmology and otolaryngology. Personnel of the department of ophthalmology and otolaryngology—resident, medical and nursing staffs. Qualifications of the medical staff to do ophthalmological and otolaryngological surgery. Control of the clinical work in the department of ophthalmology and otolaryngology. Regular periodic review and analysis of the clinical work of the ophthalmological and otolaryngological department. Essentials of the medical record for ophthalmological and otolaryngological patients. Anesthetic service for the ophthalmological and otolaryngological patients. Training of interns and nurses in the ophthalmological and otolaryngological department. Graduate training in ophthalmology and otolaryngology.

*Thursday, 2:00 p.m.—Copley-Plaza Hotel*

Round Table Conference: Administrative practices, policies, personnel; business methods; medical staff organization; medical staff conferences; medical records; diagnostic and therapeutic services; obstetrical, nursing, food and pharmacy services; outpatient department; housekeeping; maintenance and utilities; hospital auxiliaries; and other practical problems. ROBIN C. BUERKI, M.D., Philadelphia, presiding.

Collaborators: GEORGE O'HANLON, M.D., Jersey City, N. J., SIDNEY G. DAVIDSON, New Haven, Conn.; LEWIS E. JARRETT, M.D., Richmond, Va.; E. MURIEL MCKEE, R.N., Brantford, Ont.; SISTER MARY ALPHONSUS, Teaneck, N. J.; EDNA H. NELSON, R.N., Chicago; SISTER M. PATRICIA, O.S.B., Duluth, Minn.; EDNA D. PRICE, R.N., Concord, N. H.; L. V. RAGSDALE, M.D., Grand Rapids, Mich.; HELEN M. ROBINSON, R.N., Wauseon, Ohio; DAN TRANER. Lynn, Mass.; FRANK J. WALTER, Denver.

# PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY

### *Monday*

#### BOSTON CITY HOSPITAL

Staff—2. Symposium: Vascular disease.
S. J. G. NOWAK—2. Experimental hypertension.
E. A. EDWARDS—2:30. Thrombophlebitis in unusual forms.
E. E. O'NEIL—3. Lumbar sympathectomy for vascular disease.
D. C. GOLDFARB—3:30. False aneurysm of femoral artery.
T. LEARY—4. Pathological aspects of vascular disease.
E. E. O'NEIL—4:30. Refrigeration in gangrene of lower extremities.

#### COLLIS P. HUNTINGTON MEMORIAL HOSPITAL

Staff—2:15. Dry clinic:
JOSEPH C. AUB. Recent advances in our knowledge of bone diseases.
CHANNING C. SIMMONS. Malignant tumors of bone.
RICHARD DRESSER. Radiographic demonstration of bone tumors and certain rare forms of skeletal disease.
CHARLES E. DUNLAP. Carcinogenic agents.
CLIFFORD C. FRANSEEN. Industrial cancer.

#### MASSACHUSETTS GENERAL HOSPITAL

H. K. BEECHER and associates—2. Dry clinic: Anesthesia and related subjects.
H. K. BEECHER—2. Use of ether in the presence of pulmonary tuberculosis; anesthesia for transpleural gastric surgery.
JULIA G. ARROWOOD—2:25. Fractional spinal anesthesia.
H. K. BEECHER—2:35. Anesthesia and shock.
Staff—3:10 Discussion.
EDWARD B. BENEDICT—3:30. Endoscopy, bronchoscopy and esophagoscopy with special emphasis on the two newer endoscopic methods, gastroscopy and peritoneoscopy; demonstration with lantern slides and patients.
Staff—2. Symposium: Peripheral vascular disease; varicose veins and their complications.
H. H. FAXON—2. Fundamental considerations, anatomy, physiology, etiology, examination.
R. H. THOMPSON—2:15. Late results following treatment of uncomplicated varicose veins.
H. H. FAXON—2:30. Present concept of treatment.
R. R. LINTON—2:45. Chronic and recurrent ulceration of lower extremities, etiological factors and classification; present concept of treatment.
Staff—3:30. Discussion.
H. H. FAXON, R. H. THOMPSON, and R. R. LINTON—4. Operations: Peripheral vascular.
E. M. DALAND, A. O. HAMPTON, and associates—2. Dry clinic: Tumors.
A. O. HAMPTON—2. Roentgen diagnosis of cancer of the lung.
G. W. HOLMES—2:15. Roentgen treatment of cancer of the lung.
J. V. MEIGS—2:30. Changing concepts in the treatment of cancer of the cervix.
E. M. DALAND—2:45. The locus of recurrence in cancer of the breast.
R. SCHATZKI—3. End-results of roentgen therapy in cancer of the larynx.
L. L. ROBBINS—3:15. The treatment of polycythemia vera by spray radiation.
T. B. MALLORY—3:30. Malignant ulcers of the stomach.
C. E. WELCH—3:45. Gastric ulcers in relation to gastric cancer.
J. R. LINGLEY—4. Comparison of skin effect on the albino rat of 200 k.v. and 1200 k.v. roentgen ray.
G. W. TAYLOR—4:15. The value of regional dissection in cancer cases.

#### NEW ENGLAND BAPTIST HOSPITAL

H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Demonstrations: Anesthesia.

#### NEW ENGLAND DEACONESS HOSPITAL

H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Dry clinic: Anesthesia in thyroid surgery, including intratracheal anesthesia, pre-operative and post-operative medication, recent developments in spinal anesthesia.
CARL SOUDERS. Postoperative pulmonary complications
JAMES EVANS. Thrombophlebitis and pulmonary embolism.

#### NEW ENGLAND MEDICAL CENTER
(Joseph H. Pratt Diagnostic Hospital)

Staff—2. Dry clinic:
JOSEPH H. PRATT—2. Value of secretin test in diagnosis of pancreatic disease.
WILLIAM DAMESHEK—2:30. Indications for splenectomy; case reports.
JOHN D. ADAMS—3. Various conditions found in the hip joint following injury.
EDWARD L. YOUNG—3:30. Peritoneoscopy.

#### PALMER MEMORIAL HOSPITAL

Staff—2. Symposium: Carcinoma of the breast.
CLIFFORD C. FRANSEEN. End-results of surgical treatment.
L. S. MCKITTRICK. Interstitial irradiation treatment of carcinoma of the breast with platinum radium needles.
J. H. MARKS. X-ray therapy of carcinoma of the breast.
SHIELDS WARREN. Relation between chronic cystic mastitis and carcinoma of the breast.

### *Tuesday*

#### BETH ISRAEL HOSPITAL

Staff—9. Dry clinic:
ARNOLD STARR. Biliary tract disease, left-sided pain.
C. G. MIXTER. Technique of immediate cholangiography; motion pictures.
L. A. HERMANSON. Cholangiography, indications for and end-results.
H. A. FRANK. Advantages of intravenous synthetic vitamin $K_1$ over other vitamin K preparations.
A. M. SELIGMAN. Vitamin P in capillary fragility.

Staff—10:30. Operative clinic:
C. G. MIXTER. Cholecystectomy and cholangiography.
JACOB FINE. Cholecystectomy, transverse incision.
L. H. NASON. Peritoneoscopy, spinal anesthesia.
ARNOLD STARR. Peritoneoscopy, local anesthesia.
Staff—2. Dry clinic:
MAX DAVIS. Ovarian tumors with endocrine effects.
R. B. DAVIDOFF. Relationship of cystic disease of the breast to disease of the uterus and adnexa.
L. A. HERMANSON. Comparative merits of the vaginal smear and endometrial biopsy in diagnosis of ovarian function.
S. L. CARGILL. Hyperparathyroidism.
D. D. BERLIN. Carcinoma of the thyroid.
M. F. LESSES. Complications of thyroid surgery.
S. L. CARGILL. Management of recurrent and persistent thyrotoxicosis.
D. D. BERLIN. The avoidance of complications in thyroid surgery.

SCIENTIFIC EXHIBIT (Daily, 9 to 5)

JOSEPH GOODMAN. Pathogenic fungi in foot infections.
H. F. FRIEDMAN. Malignant disease before and after treatment by radiation.
ABRAHAM RUDY and S. R. MUELLNER. Neurogenic bladder in diabetes mellitus.
JULIUS LOMAN. Action of autonomic drugs on the gastro-intestinal and genito-urinary tracts.
S. A. ROBINS. Urethrography and cystography.
W. S. ALTMAN and L. A. HERMANSON. Cholangiography.
LEONARD NATHAN and KURT THOMA. Cysts and tumors of mouth and jaw.
JULIUS LOMAN. Cerebral arteriography.
A. STARR and H. FRANK. Venography in deep phlebitis of lower leg.
S. HANFLIG. Mechanical device for reduction of Colles' fracture.

## BOSTON CITY HOSPITAL

Staff—2. Dry clinic: Gastric lesions.
W. R. MORRISON—2. Gastrojejunocolonic fistula.
C. W. MCCLURE—2:30. Gastroscopy, kodachrome pictures.
A. R. KIMPTON—3. Cancer of stomach.
W. R. MORRISON—3:30. Perforated peptic ulcer.
E. E. O'NEIL—4. Transpleural approach for carcinoma of upper end of stomach.
T. W. WICKHAM—4:30. Cholecystitis and its relation to peptic ulcer. Review of 600 cholecystectomies.

## PETER BENT BRIGHAM HOSPITAL

ELLIOTT C. CUTLER and ROBERT E. GROSS—9. Operations: Ligation of patent ductus arteriosus; pericardiectomy.
ELLIOTT C. CUTLER and associates—10. Symposium: Surgery of the heart and blood vessels.
C. SIDNEY BURWELL. Forms of heart disease amenable to surgery.
SAMUEL A. LEVINE. Cardiac disease simulating surgical conditions of the abdomen and vice versa.
EUGENE C. EPPINGER. Indications for surgery for patent ductus arteriosus.
ROBERT E. GROSS. Surgical treatment of patent ductus arteriosus.
ELLIOTT C. CUTLER. The technique of pericardiectomy.
MERRILL C. SOSMAN. The rôle of the roentgenologist in cardiac surgery.
JOHN HOMANS. Peripheral vascular disease.
MARSHALL N. FULTON. Angioma of skeletal muscle.
DAVID CHEEVER—2. Surgical anatomy of the abdomen.

## CHILDREN'S HOSPITAL

WILLIAM E. LADD and associates—10:30. Dry clinic: Diseases of the gastro-intestinal tract in childhood, followed by questions and discussion.
WILLIAM E. LADD. Atresia, stenosis, and malrotation.
THOMAS H. LANMAN. Pyloric stenosis.
ROBERT E. GROSS. Intussusception.
HENRY W. HUDSON, JR. Appendicitis.

## MASSACHUSETTS GENERAL HOSPITAL

A. W. ALLEN and associates—8. Symposium: Gastric lesions.
C. M. JONES—8. Medical considerations.
A. O. HAMPTON and associates—8:30. Roentgenological studies.
E. B. BENEDICT—8:50. Gastroscopy and peritoneoscopy.
C. E. WELCH—9:10. Gastric ulcer.
LANGDON PARSONS—9:30. Cancer of the stomach.
R. H. SWEET—9:50. Transthoracic gastrectomy.
A. W. ALLEN—10:10. Surgical procedures for gastric lesions.
Staff—10:30. Operations: Gastric resections for benign and malignant lesions.
H. H. FAXON, HORATIO ROGERS, and associates—9. Symposium: Acute appendicitis.
HORATIO ROGERS. Present status; chief factors in present mortality rates, late diagnosis and/or treatment, faulty appraisal of individual patients, rigid policies of treatment, faulty technique, type of incision.
W. D. SMITH. Appendicitis in general medical practice.
HORATIO ROGERS. Appendiceal peritonitis before localization.
H. H. FAXON. Appendiceal peritonitis after localization.
CHAMP LYONS. The rôle of bacteriology and chemotherapy in appendicitis.
R. R. LINTON. Special aspects of appendicitis in young children.
Staff—11. Operative clinic.
L. S. MCKITTRICK and associates—2. Symposium: Surgery of the colon and rectum.
L. S. MCKITTRICK—2. Operations for carcinoma of the rectum and their indications.
A. W. ALLEN—2:20. The management of carcinoma of the colon.
E. P. HAYDEN—2:40. The complications of diverticulitis of the sigmoid and their management.
ROY E. MABREY—3. The operative and non-operative management of internal hemorrhoids.
Staff—3:20. Discussion.
Staff—3:40. Operative clinic.
CHAMP LYONS and FRANK L. MELENEY (New York)—2. Dry clinic: Surgical infections.

## MASSACHUSETTS MEMORIAL HOSPITALS

HOWARD M. CLUTE, CLIFFORD D. HARVEY, CHARLES SZIKLAS, FRANK E. BARTON, and HOLLIS L. ALBRIGHT—8. Operative clinic: Thyroid, gall-bladder, stomach, and colon.
ELEANOR FERGUSON, REGINALD HUNT, and M. JEAN BLACK. Demonstrations: Anesthesia.
Staff—10. Symposium: Management of blood-bank.
FRANK E. BARTON. Management of a blood-bank in a small hospital.
CHARLES BRANCH. Correlation of the hospital laboratory with the blood-bank.
JOHN SCUDDER (New York). Studies in treatment of shock with plasma and serum.
CORNELIUS P. RHOADS (New York). Present application and future development of blood substitute therapy.

PHILLIPS L. BOYD—10. Dry clinic: Lymphogranuloma venereum with rectal involvement.
FRANK E. BARTON—2. Demonstration of transfusion service.
Staff—2. Symposium: Surgery of the biliary tract.
KNOWLES LAWRENCE—2. Intrinsic disease of the liver simulating cholecystitis.
HOLLIS L. ALBRIGHT—2:20. Non-calculous gall bladder.
THOMAS J. ANGLEM—2:40. Complications of common duct surgery.
FRANZ INGLEFINGER—3. Duodenal drainage in diagnosis of biliary tract disease.
CHESTER KEEFER—3:20. Liver abscess as a cause of prolonged fever.
HOWARD M. CLUTE—3:40. Stricture of the bile ducts.

### NEW ENGLAND BAPTIST HOSPITAL

F. H. LAHEY, R. B. CATTELL, S. F. MARSHALL, and B. P. COLCOCK—9. Operative clinic: Thyroid, stomach, colon, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—9. Anesthesia demonstrations: Regional, spinal, continuous spinal, and general.
H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Demonstrations: Anesthesia.

### NEW ENGLAND DEACONESS HOSPITAL

F. H. LAHEY, R. B. CATTELL, S. F. MARSHALL, and B. P. COLCOCK—9. Operative clinic: Thyroid, stomach, colon, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—9. Anesthesia demonstrations: Regional, spinal, continuous spinal, and general.
H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Demonstrations: Anesthesia.
F. H. LAHEY, LEWIS M. HURXTHAL, ELMER C. BARTELS, and H. J. PERKINS—2. Symposium: Thyroid surgery: Subtotal thyroidectomy; diagnosis of hyperthyroidism; diagnosis and treatment of the thyrocardiac; complications following thyroid surgery; recent developments in blood iodine studies.

### NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

ELEANOR E. COWAN—10. Out-patient clinics: Gynecological, medical, and pediatric.
G. LINDH MULLER—10. Pathological presentation: Carcinoid tumor of small intestine, metastases to liver; carcinoma of gastro-intestinal tract.
RACHEL L. HARDWICK, BIANCA R. LIA, and MERRY E. PITTMAN—2. Dry clinic: Correlation of electrostethocardiography with roentgenography in rheumatic heart disease, congenital heart disease, and functional abnormalities, with presentation of cases.

### NEW ENGLAND MEDICAL CENTER
(Joseph H. Pratt Diagnostic Hospital)

Staff—2. Dry clinic:
EDWARD T. WHITNEY—2. Bleeding per ano, illustrated with lantern slides.
C. H. LAWRENCE—2:30. Masculinizing factors in the female.
K. S. ANDREWS, HENRY H. LERNER, and WILLIAM M. SHEDDEN—3:30. Recent advances in diagnosis and treatment of cancer of the stomach.

### PONDVILLE HOSPITAL

E. M. DALAND, G. W. TAYLOR, H. ROGERS, T. J. ANGLEM, R. H. WALLACE, and associates—9. Operative clinic: Cancer.
Staff—11. Dry clinic:
E. M. DALAND. End-results in cancer of the breast.
T. J. ANGLEM. Cancer of the mouth, demonstration of cases.
G. W. TAYLOR. Lymph node metastases.
S. WARREN and associates. Pathological demonstration.
C. E. DUMAS and associates. Roentgen demonstration of bone tumors.

### ST. ELIZABETH'S HOSPITAL

Staff—9. Operative and dry clinic:
JOSEPH STANTON—9. Thyroidectomy.
MICHAEL E. MCGARTY—9. Bilateral recurrent inguinal hernia.
JOSEPH STANTON—10. Biliary tract operation.
FRANCIS JANTZEN—10:30. Discussion of sub-deltoid bursitis and ruptured supraspinatus tendon.
WILLIAM F. DOLAN—11. Wrist injuries in industry.
MICHAEL E. MCGARTY—11:30. Skin grafts, demonstration of cases.

### SALEM HOSPITAL

W. G. PHIPPEN, DONALD A. NICKERSON, and S. A. WILSON—10. Dry clinic: Uses and abuses of laboratory and roentgenological procedures in abdominal surgery.
E. L. PEIRSON—11. Prostatic surgery with some newer methods of diagnostic approach.

### UNITED STATES MARINE HOSPITAL

RICHEY L. WAUGH and associates—8. Operative clinic: Hernioplasty, indirect, direct, and femoral; appendectomy; ligation of saphenous vein; hemorrhoidectomy.
RICHEY L. WAUGH and associates—1. Dry clinic:
JAMES F. SPINDLER. Parasitic appendicitis.
KENNETH HAUSFELD. Femoral hernia, a simple operation with report of cases.
RICHEY L. WAUGH. Terminal ileitis.
JOHN A. PRIOR. Rupture of spleen, delayed hemorrhage.

### UNITED STATES NAVAL HOSPITAL

J. J. A. MCMULLIN and staff—9. Operations.

## *Wednesday*

### BETH ISRAEL HOSPITAL

Staff—9. Dry clinic:
L. H. NASON. Pressure treatment of keloids.
J. B. SEARS. Prophylaxis of pulmonary embolism by division of femoral vein.
EDWARD HIRSCH. Changes in volume of the peritoneal cavity following intercostal nerve paralysis.
C. G. MIXTER. Giant hernia.
ARNOLD STARR. Advanced regional ileitis.
C. G. MIXTER. Transverse ileocolostomy with or without resection for regional ileitis.
Staff—10:30. Operative clinic:
C. G. MIXTER. Intestinal resection.
J. B. SEARS. Division of femoral vein for treatment of non-fatal pulmonary embolus.
D. D. BERLIN. Thyroidectomy.
Staff—2. Dry clinic:
M. D. ALTSCHULE. Obstruction of superior vena cava.
BENJAMIN ALEXANDER. Blood-bank.
MAX DAVIS and SAMUEL GILMAN. Venous pressure changes in lower extremities during and after abdominal surgery.
S. B. BEASER. Rare earth anticoagulants.

JACOB FINE. Thrombophlebitis and embolism, diagnostic and therapeutic considerations.
BENJAMIN ALEXANDER. Polycythemia vera in peripheral vascular disease.
B. F. MASSELL and S. B. BEASER. Evaluation of therapy of peripheral vascular disease.
JACOB FINE. Adrenal cortical hormones in shock and hemorrhage.

## BOSTON CITY HOSPITAL

Staff—9. Symposium: Cancer.
Department of Pathology—9. Splenogenic myeloid metaplasia; argentophil tumors (carcinoid).
DR. JOLIFF—9:30. Surgical treatment of myeloma.
F. W. O'BRIEN—9:50. Cancer and x-ray therapy.
E. A. COONEY—10:20. Carcinoma of breast.
A. R. KIMPTON—10:45. Cancer of large intestine.
CHARLES LUND—11:10. Cancer of mouth.
WILLIAM MORRISON—11:35. Cancer of stomach.
Staff—2. Symposium: Thyroid disease.
R. C. COCHRANE—2. Tumors of parathyroid, lantern slides.
D. D. BERLIN—2:30. Hyperthyroidism in cancer of thyroid.
W. T. SALTER—2:50. Graves' disease without hypertension.
RICHARD SMITH—3:10. Adenoma of thyroid.
Staff—3:30. Symposium: Vitamins in surgery.
CHARLES LUND and J. H. CRANDON—3:30. Vitamin C and wound healing.
WALTER WEGNER and MERRILL MOORE—4:15. Vitamins in presence of head injuries.
DR. MIKELJOHN—4:45. Presentation of cases.
Staff—2. Dry clinic:
GORDON M. MORRISON—2. Radial nerve injury with fracture of humerus.
J. EDWARD FLYNN—2:30. Anatomical and clinical investigations of deep fascial space abscess of hand.
T. K. RICHARDS—3:15. Traumatic injuries of the knee joint.
A. P. AITKEN—3:45. Epiphyseal separation.
ROBERT ULIN—4:30. Clubfeet.

## PETER BENT BRIGHAM HOSPITAL

ELLIOTT C. CUTLER and ROBERT ZOLLINGER—9. Operations: Gastric resections.
ELLIOTT C. CUTLER and associates—10. Symposium: Gastric and duodenal ulcer.
ELLIOTT C. CUTLER. Indications for surgery.
EDWARD S. EMERY, JR. Medical management of bleeding peptic ulcer.
MERRILL C. SOSMAN. Significance of prepyloric ulcer.
HARRY A. WARREN. Duodenal diverticulum.
ROBERT ZOLLINGER. Surgical treatment of severe duodenal ulcer.
ELLIOTT C. CUTLER. Results of acute gastroduodenal perforation.
CARL W. WALTER—2. Symposium: Aseptic technique.

## CARNEY HOSPITAL

A. MCK. FRASER, WILLIAM E. BROWNE, and staff—9. Operative clinic: Gastro-intestinal, biliary tract, thyroid, and hand.
Staff—2. Dry clinic:
WILLIAM E. BROWNE. Moving picture demonstration and brief description of unusual lesions of arm, forearm, and hand, showing condition present before treatment and end-results. Cases will include xanthomata, glomus tumor, so-called trigger finger contractures, aneurysms in hand, melanotic carcinoma, tendon suture repair with transplanted segment of vein for covering at site of anastomosis, difference between real and pseudo-neuromata in amputation stumps, ulnar nerve repair, series of median nerve cases, results in a series of cases following radical operation for relief of Dupuytren's contracture with 90 to 100 per cent return of normal function of the hand.
DAVID C. DITMORE. Vital tissue staining, its practical application in office and hospital proctology, with report of results in a series of 1000 private patients.
W. R. MACAUSLAND. Fracture and dislocation of carpal-semilunar bones.
HAROLD G. LEE. End-results in lumbosacral fusion; end-results of epicondylar fractures of humerus.
A. LEO BRETT. Case presentation of myeloma of 12 years' duration with complete absorption of tenth vertebra.
JOHN L. DOHERTY. A simple method of treating fractures of surgical neck of humerus.
WILLIAM C. MALONEY. Practical application of clinical laboratory procedures in jaundice.
A. MCK. FRASER. End-results of gall-bladder surgery.

## CHILDREN'S HOSPITAL

WILLIAM E. LADD and associates—9. Operations.

## DILLON FIELD HOUSE

(Soldier's Field, Allston)

AUGUSTUS THORNDIKE, JR., and associates—3. Dry clinic: Athletic injuries. Summary of recent developments in the physiology of physical fatigue.

## FAULKNER HOSPITAL

Staff—8. Operative and dry clinic:
E. L. YOUNG, A. R. KIMPTON, F. G. BALCH, H. K. SOWLES, R. F. SHELDON, E. E. O'NEIL, R. S. TITUS, and R. J. HEFFERNAN. Operations.
S. C. WIGGIN. Anesthesia exhibits.
J. B. HAZARD. Pathological specimens, gross and microscopic.
Staff—2. Operative and dry clinic:
A. R. KIMPTON—2. Gastric resection.
H. K. SOWLES—2:15. Reconstruction operation for hypertrophied breast.
E. L. YOUNG—2:30. Stricture of papilla of vater.
R. C. COCHRANE—2:45. Parathyroid tumors.
WM. C. QUINBY—3. Importance of water balance in diseases of the prostate.
E. E. O'NEIL—3:15. Prevention of pulmonary embolism by ligation and division of femoral vein.
R. F. SHELDON—3:30. Local infiltration anesthesia for pelvic delivery.
R. J. HEFFERNAN—3:45. Use of progesterin in treatment of habitual and threatened abortion.
DR. MALONEY—4. Management of bleeding in jaundice.
R. S. TITUS—4:15. Diabetes in pregnancy.
DR. STRAUSS—4:30. Importance of vitamins.
S. C. WIGGIN—4:45. Anesthesia for complicated surgical cases.

## MALDEN HOSPITAL

LOUIS E. PHANEUF—9. Operation: Vaginal hysterectomy.
IRVING J. WALKER—9. Operation: Cholecystectomy.
Staff—10. Dry clinic and demonstrations:
GORDON D. ATKINSON—10. Urology.
RUSSELL F. SULLIVAN—11. Orthopedic surgery.
LOUIS E. PHANEUF—11:30. Gynecology.
IRVING J. WALKER—12. Ludwig's angina.
J. S. ROONEY—12:30. Pathology.
KENNETH K. DAY—1. Blood-bank.

Staff—2. Operative clinic:
GORDON D. ATKINSON—2. Nephrectomy.
N. A. GALLAGHER—2:30. Hysterectomy.
RUSSELL F. SULLIVAN—3:30. Spinal fusion (Hibbs').

## MASSACHUSETTS GENERAL HOSPITAL

E. D. CHURCHILL and associates—9. Symposium and clinic: Primary tumors of the lung and esophagus.
D. S. KING—9. Medical aspects of primary carcinoma of the lung.
E. D. CHURCHILL—9:20. Types of operations and results in carcinoma of the lung.
R. H. SWEET—9:50. Resection of the lung for metastatic sarcoma.
R. H. SWEET—10. Surgical treatment of carcinoma of the lower third of the esophagus and cardiac area of the stomach.
E. D. CHURCHILL—10:30. Surgical treatment of carcinoma of the upper two-thirds of the esophagus.
ROBERT KLOPSTOCK—10:45. Discussion and exhibition of gross pathological specimens.
Staff—11. Operations.
L. S. MCKITTRICK and associates—9. Operative and dry clinic: Ulcerative colitis.
C. M. JONES—9. Medical aspects, diagnosis and treatment.
L. S. MCKITTRICK—9:20. Surgical aspects, types of operations and indications.
J. D. STEWART—9:40. Ileostomy, operative technique, postoperative complications.
RICHARD WARREN—10:10. Late-results after ileostomy, social and economic aspects.
L. S. MCKITTRICK—10:30. Colectomy, indications, technique and results.
Staff—10:45. Discussion.
Staff—11. Operations.
H. C. MARBLE and associates—9. Dry clinic: Surgical conditions of the hand.
H. C. MARBLE. Anatomy and examination.
F. G. BALCH, JR. Hand tumors.
EDWARD HAMLIN, JR. Injuries to nerves of upper extremity.
BRADFORD CANNON. Skin grafts of hand.
A. L. WATKINS. Physiotherapy in reconstruction.
A. W. REGGIO. Occupational therapy in reconstruction.
H. C. MARBLE. Surgical reconstruction.
A. W. ALLEN and associates—2. Symposium: Diseases of the gall bladder and bile ducts.
A. W. ALLEN—2. Technical considerations of the gall bladder and bile ducts with special reference to morbidity and mortality.
RICHARD WALLACE—2:30. Acute cholecystitis.
J. D. STEWART—2:50. Obstructive jaundice, liver function, preparation of the patient and after-care.
RICHARD WARREN—3:15. Carcinoma of the gall bladder.
Staff—3:30. Operative clinic: Extrahepatic biliary tract.
Staff—2. Symposium: Peripheral vascular clinic; obliterative arterial disease.
L. S. MCKITTRICK—2. Fundamental considerations, classification, differential diagnosis.
EDWARD HAMLIN, JR.—2:15. Thrombo-angiitis obliterans: Outline of treatment, nerve crushing, mechanical aids, indications for amputation.
H. E. KENNARD—2:35. Thrombo-angiitis obliterans: End-result study with particular reference to the economic aspect of the disease.
RICHARD WARREN—2:55. Arteriosclerotic gangrene with and without diabetes, indications for and technique of minor amputation.
T. C. PRATT—3:10. Arteriosclerotic gangrene with and without diabetes, indications for and technique of supracondylar amputation.
R. H. SMITHWICK—3:30. Lumbar sympathectomy, its rôle in the treatment of obliterative disease; indications for operation and operative technique.
Staff—3:50. Discussion.
Staff—4. Operative clinic: Supracondylar amputation for gangrene, nerve crushing for relief of pain, lumbar sympathectomy.

## MASSACHUSETTS MEMORIAL HOSPITALS

HOWARD M. CLUTE, CLIFFORD D. HARVEY, CHARLES SZIKLAS, FRANK E. BARTON, and HOLLIS L. ALBRIGHT—8. Operative clinic: Thyroid, gall-bladder, stomach, and colon.
ELEANOR FERGUSON, REGINALD HUNT, and M. JEAN BLACK. Demonstrations: Anesthesia.
GEORGE LEVENE and EGON G. WISSING—9:30. Demonstration: X-ray examination of the rectum and sigmoid with special reference to lateral view.
Staff—10. Symposium: Gastric surgery.
HOWARD M. CLUTE. Gastric hemorrhage.
JOHN SPRAGUE. End-result studies after gastroduodenostomy.
FRANZ INGLEFINGER. Miller-Abbott tube in gastrointestinal diagnosis.
THOMAS J. ANGLEM. Cancer of the stomach.
ELEANOR FERGUSON. Anesthesia for upper abdominal surgery.
FRANK E. BARTON—2. Demonstration of transfusion service.

## NEW ENGLAND BAPTIST HOSPITAL

F. H. LAHEY, R. B. CATTELL, S. F. MARSHALL, and B. P. COLCOCK—9. Operative clinic: Thyroid, stomach, colon, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—9. Anesthesia demonstrations: Regional, spinal, continuous spinal, and general.
H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Demonstrations: Anesthesia.

## NEW ENGLAND DEACONESS HOSPITAL

F. H. LAHEY, R. B. CATTELL, S. F. MARSHALL, and B. P. COLCOCK—9. Operative clinic: Thyroid, stomach, colon, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—9. Anesthesia demonstrations: Regional, spinal, continuous spinal, and general.
H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Demonstrations: Anesthesia.
R. B. CATTELL, N. W. SWINTON, and EVERETT D. KEIFER—2. Dry clinic: Diagnosis and treatment of carcinoma of rectum; rectal surgery for benign lesions; diagnosis and treatment of ulcerative colitis.
JOHN NORCROSS. Avitaminosis and recent developments in intravenous use of heperin.

## NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

Staff—10. Out-patient clinics: Gynecological, skin and allergy, pediatric and well baby.
G. LINDH MULLER—10. Pathological demonstration: Breast cancer.

### NEW ENGLAND MEDICAL CENTER
### (Joseph H. Pratt Diagnostic Hospital)

Staff—9. Dry clinic:
- RICHARD H. OVERHOLT—9. The operability of primary carcinoma of the lung.
- REEVE H. BETTS—9:30. The management of acute pulmonary abscess.
- H. E. MACMAHON—10. Gastric lesions in malignant hypertension.
- S. J. THANNHAUSER—10:30. Liver function tests as an aid to gall-bladder surgery.

### NEWTON HOSPITAL

Staff—9. Operative clinic:
- G. KENNETH COONSE—9. A new arthroplasty of the hip.
- LOUIS PILCHER—9. Appendectomy.
- R. I. SMITH—9:30. Thyroidectomy for hyperthyroidism.
- M. P. BRACKETT—9:30. Cholecystectomy.
- D. G. NUTTER—10. Hysterectomy for fibroids.
- E. D. LEONARD—10. Breast amputation.
- HERBERT DUNPHY—11. Skin graft.

Staff—2. Dry clinic.
- G. K. COONSE. Diagnosis and treatment of shoulder injuries.
- R. I. SMITH. Tumors of the neck.
- G. D. NUTTER. New apparatus for fractures of the clavicle.
- CHARLES LAMB. Peripheral vascular clinic.
- H. G. DUNPHY. Management of cicatricial contractures due to burns, skin grafting in general.
- E. D. LEONARD. Arterial thrombosis in a young girl.

### ST. ELIZABETH'S HOSPITAL

Staff—9. Operative and dry clinic:
- JOHN W. SPELLMAN—9. Surgery of the breast.
- JOSEPH STANTON—9. Gastric surgery.
- EDWARD M. HODGKINS—9. Herniorrhaphy, fascial strips.
- LAWRENCE J. LOUIS—10. Cholecystectomy.
- JOHN G. DOWNING—11. Surgical complications due to fungi. Colored motion picture, "A Clinical and Laboratory Study of Fungous Diseases."
- JOHN W. SPELLMAN—11. Treatment of advanced cancer, demonstration of cases.
- WILLIAM NOONAN—11:45. Spinal anesthesia.

### UNITED STATES NAVAL HOSPITAL

LAWRENCE J. MCCARTHY and staff—9. Operations.
JOHN R. MARSHALL and CHARLES H. SWAN—9. Dry clinic. Circulatory diseases of the extremities, case histories.

## *Thursday*

### BETH ISRAEL HOSPITAL

Staff—9. Dry clinic:
- S. S. HANFLIG. Use of traction in treatment of cervical arthritis.
- MYER KARP. Treatment of acute subdeltoid bursitis by needling, novocain and irrigation; mechanics of fracture of surgical neck of humerus, methods of reduction.
- M. H. ROGERS. Manipulation for chronic adhesive bursitis.
- ARMIN KLEIN. Chemotherapy of acute sepsis of bones and joints.
- W. S. ALTMAN. Delayed roentgenological evidence of fracture.
- ARMIN KLEIN. Intervertebral disc, orthopedic aspects.
- W. JASON MIXTER. Intervertebral disc, neurological and surgical aspects.
- DAVID AYMAN. Results of sympathectomy for hypertension.

Staff—10:30. Operative clinic:
- R. H. SMITHWICK. Sympathectomy for hypertension.
- W. JASON MIXTER. Removal of intervertebral disc.
- M. H. ROGERS. Arthrotomy of shoulder joint.

Staff—2. Dry clinic:
- ALFRED HURWITZ. Sulfanilamide vs. zinc peroxide in the treatment of phagedenic ulcer.
- LOUIS ZETZEL. The Miller-Abbott tube.
- M. D. ALTSCHULE. Effect of abdominal surgery on respiratory dynamics.
- H. L. BLUMGART. The surgical risk in cardiac patients.
- JACOB FINE. Treatment of intestinal distention by sulfaguanidine.
- ARNOLD STARR. Sulfaguanidine for the sterilization of isolated loops of colon.

### BEVERLY HOSPITAL

Staff—2. Dry clinic:
- PEER P. JOHNSON. Acute pancreatic disease, its diagnosis and treatment.
- BARNARD P. TODD. Adenoma of the islets of Langerhans.
- RICHARD E. ALT. Abdominal manifestations of renal disease.
- PEER P. JOHNSON and HAMMOND J. DUGAN. Results of deferred operation in acute perforated appendicitis.
- JOSEPH A. CUNNINGHAM. A clinicopathological study of abdominal Hodgkin's disease.

### BOSTON CITY HOSPITAL

OTTO J. HERMANN and associates—9. Symposium: Low back pain.
- OTTO J. HERMANN—9. Introduction.
- JOHN T. WILLIAMS—9. Gynecological aspects.
- AUGUSTUS RILEY—9:15. Genito-urinary aspects.
- ROBERT ULIN—9:30. A rational method of routine back examination based on anatomical and physiological factors.
- JOSEPH SHORTELL—9:45. Low back pain with negative x-ray, lumbosacral; sacro-iliac myositis; myositis fascitis, industrial postural, mechanical findings.
- THOMAS H. PETERSON—10. Coccygodynia fracture of coccyx, conservation vs. surgery in treatment.
- RUSSELL SULLIVAN—10:15. Anatomical abnormalities of fifth lumbar vertebra and lumbosacral joint.
- G. KENNETH COONSE—10:30. Spondylolisthesis, pathology, diagnostic points, role of trauma in its production and treatment.
- A. P. AITKEN—10:45. Fascial contractions.
- MARK H. ROGERS—11. Intervertebral disc problem, orthopedic aspect.
- P. F. BUTLER—11:15. Intervertebral disc problem, x-ray aspect.
- DONALD MUNRO—11:30. Intervertebral disc problem, neurological aspect.

Staff—2. Operative and dry clinic: Appendicitis, biliary system, and hernia.
- P. S. FOISIE—2. Appendicitis and complications.
- G. W. PAPEN—2:30. Incision for appendectomy in extreme obesity.
- F. F. HENDERSON and JOHN MCGOWAN—3. Operative biliary drainage for relief of jaundice, operative care of gall-bladder patient.
- J. J. HEPBURN—3:20. Familial hemolytic jaundice and splenectomy.
- W. R. MORRISON—3:40. Stones of the hepatic ducts subdiaphragmatic abscess.
- CHARLES LAMB—4. Peritoneoscopy with special reference to biliary disease.

RICHARD SMITH—4:20. Exteriorization of small intestines in strangulated hernia.
D. C. GOLDFARB—4:40. Recurrent inguinal hernia.
Staff—2. Symposium: Anesthesia, and abdominal surgery.
T. W. WICKHAM—2. Foci of infection and ulcerative colitis.
A. R. KIMPTON—2:15. Surgery of large intestine.
C. W. MCCLURE—2:30. Sigmoidoscopy, kodachrome pictures.
FRANK MARVIN—2:45. Indications and contra-indications for various anesthetics.
S. C. WIGGIN—3. Spinal anesthesia.
G. C. MOORE—3:15. Intravenous anesthesia.
P. S. FOISIE—3:30. Ruptured corpus hemorrhagicum.
ALLEN DAVIS—3:45. Calcified cyst of spleen.
S. J. MADDOCK—4. High and low intestinal obstruction.
ALLEN DAVIS—4:20. Gun shot wounds of abdomen.
HALSEY B. LODER—4:40. Postoperative treatment.

## PETER BENT BRIGHAM HOSPITAL

FRANCIS C. NEWTON and J. ENGLEBERT DUNPHY—9 Operations: Colon, rectum and anus.
ELLIOTT C. CUTLER and associates—10. Symposium: Colon, rectum and anus.
FRANCIS C. NEWTON. Experiences with cancer of the colon.
J. ENGLEBERT DUNPHY. Experiences with anterior resection for cancer of the rectosigmoid.
ANDREW W. CONTRATTO and THOMAS B. QUIGLEY. Differential diagnosis of gastritis, gastro-enteritis and appendicitis.
MERRILL C. SOSMAN. The x-ray and large bowel surgery.
EDWARD S. EMERY, JR. Medical diseases of the colon.
ELLIOTT C. CUTLER. Cicatrizing enteritis.

## CARNEY HOSPITAL

A. MCK. FRASER, WILLIAM E. BROWNE, and staff—9. Operative clinic: Gastro-intestinal, biliary tract, thyroid, and hand.
Staff—2. Dry clinic:
WILLIAM E. BROWNE. Results of thyroid surgery on a general surgical service during the past 3 years, accuracy of diagnosis and careful pre-operative preparation, types of operative procedure carried out, end-results.
ROGER C. GRAVES. Management of prostatic obstruction.
WESTON T. BUDDINGTON. Injuries of the ureter.
CHARLES KICKHAM. Non-calculous obstruction of the urethral pelvic junction.
ROBERT H. ALDRICH. English experience with war burns.
JOHN J. TODD. Use of sulfathiazole in surgical infections.
CHARLES A. ROBINSON. Treatment of varicose ulcer.
TIMOTHY E. P. LYONS. Results of 3 years' study of carcinoma of the large bowel.
EDWARD T. WHITNEY. Treatment of fissure in ano.

## CHILDREN'S HOSPITAL

WILLIAM E. LADD and associates—9. Dry clinic: Plastic surgery in children, followed by questions and discussion.
WILLIAM E. LADD. Harelip and cleft palate.
DONALD W. MACCOLLUM. Early and late treatment of burns.
WILLIAM E. LADD. Hands, syndactylism, polydactylism.
ROBERT E. GROSS. Plastic operations on the anus.
WILLIAM E. LADD and associates—10:30. Dry clinic, followed by questions and discussions.
THOMAS H. LANMAN. Radical treatment of chronic lung suppuration.
ROBERT E. GROSS. Surgical treatment of patent ductus arteriosus.
FRANC D. INGRAHAM. Subdural hematoma; brain tumors in infancy and childhood.

## FAULKNER HOSPITAL

Staff—2. Operative and dry clinic:
E. G. BRACKETT—2. His operation.
H. C. MARBLE—2:15. Wringer hands.
HARVEY MORRISON—2:30. Bony block in arthritic knees corrected by operation, motion pictures.
OTTO J. HERMANN—2:55. Os calcis fractures, motion pictures.
DR. NEWTON—3:10. Thoracic surgery.
JOHN ADAMS—3:25. Hip cases, drilling and pinning.
H. L. JOHNSON—3:45. Stimulation of fracture repair by embryological regime.
JOHN HOMANS, C. G. MIXTER, R. H. SMITHWICK, DR. WHITE, E. E. O'NEIL, H. C. MARBLE, and J. S. HODGSON—4. Symposium: Causalgia.

## COLLIS P. HUNTINGTON MEMORIAL HOSPITAL

Staff—2:15. Dry clinic:
GRANTLEY W. TAYLOR. Choice of treatment in cancer of the oral cavity.
DAVID WEISBERGER. Changes in the oral mucous membrane due to vitamin deficiency.
SHIELDS WARREN. Treatment of leukemia by radioactive substances.
IRA T. NATHANSON. Relation of the hormones to malignant diseases.

## MASSACHUSETTS GENERAL HOSPITAL

A. W. ALLEN and associates—8. Symposium: Duodenal ulcer.
C. M. JONES and associates—8. Medical considerations.
A. O. HAMPTON and associates—8:30. Roentgenological diagnosis.
E. B. BENEDICT—8:50. Gastroscopy, gastritis.
A. W. ALLEN—9:10. Surgical considerations.
HOWARD ULFELDER—9:40. Acute perforation.
C. E. WELCH—10:10. Malfunction of anastomotic stoma and after-care.
Staff—10:30. Operative clinic.
V. H. KAZANJIAN—8. Operative and dry clinic: Plastic surgery, presentation of cases operated upon for various deformities.
L. S. MCKITTRICK and associates—2. Operative and dry clinic: Acute small bowel obstruction.
RICHARD WARREN—2. Physiological aspects of non-strangulation obstruction, cause of death.
L. S. MCKITTRICK—2:20. Factors influencing mortality rate.
S. P. SARRIS—2:40. Diagnosis.
RICHARD WARREN—3:10. Non-operative treatment, practical consideration in the use of the Miller-Abbott tube.
L. S. MCKITTRICK—3:30. Résumé, outline of treatment, results.
Staff—3:45. Discussion.
Staff—4. Operations.

## MASSACHUSETTS MEMORIAL HOSPITALS

HOWARD M. CLUTE, CLIFFORD D. HARVEY, CHARLES SZIKLAS, FRANK E. BARTON, and HOLLIS L. ALBRIGHT—8. Operative clinic: Thyroid, gall-bladder, stomach and colon.
ELEANOR FERGUSON, REGINALD HUNT, and M. JEAN BLACK. Demonstrations: Anesthesia.

Staff—10. Symposium: Sulfonamides.
CHESTER S. KEEFER. Use of sulfonamides in bacteremia.
HOWARD M. CLUTE. Use of sulfonamides in peritoneal cavity.
HOLLIS L. ALBRIGHT. Massive infection of abdominal wall and of the extremities, demonstration of cases.
SAMUEL N. VOSE. Use of sulfonamides in genito-urinary surgery.
LEIGHTON F. JOHNSON. Use of sulfonamides in nose and throat infections.
ARTHUR L. HANRAHAN—10. Operative and dry clinic: Treatment of varicose veins and ulcers.

### NEW ENGLAND BAPTIST HOSPITAL

F. H. LAHEY, R. B. CATTELL, S. F. MARSHALL, and B. P. COLCOCK—9. Operative clinic: Thyroid, stomach, colon, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—9. Anesthesia demonstrations: Regional, spinal, continuous spinal, and general.
H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Demonstrations: Anesthesia.

### NEW ENGLAND DEACONESS HOSPITAL

F. H. LAHEY, R. B. CATTELL, S. F. MARSHALL, and B. P. COLCOCK—9. Operative clinic: Thyroid, stomach, colon, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—9. Anesthesia demonstrations: Regional, spinal, continuous spinal, and general.
H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum, and biliary tract.
U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Demonstrations: Anesthesia.
F. H. LAHEY, SARA M. JORDAN, and S. F. MARSHALL—2. Dry clinic: Technique of subtotal and total gastrectomy; medical and surgical management of duodenal and gastric ulcer; treatment of gastrojejunal colic fistula.
HERBERT ADAMS. Diagnosis and treatment of regional ileitis.

### NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

Staff—10. Out-patient clinics: Gynecological, medical, and pediatric.
G. LINDH MULLER—10. Pathological demonstration: Ovarian tumors.
ELSIE BROWN and ILIA GALLEANI—2. Dry clinic: Metabolism.

### NEW ENGLAND MEDICAL CENTER
(Boston Floating Hospital)

Staff—2. Dry clinic:
REEVE H. BETTS and ALFRED WELLER—2. Pulmonary suppuration, treatment of empyema in children.
RICHARD WAGNER and W. S. LEVENSON—2:30. Endocrinology and surgery.
FRANCIS MCDONALD and R. G. FREEMAN—3. Appraisal of the host, nutrition, personality.
FRANCIS MCDONALD, W. S. LEVENSON, NICHOLAS WERTHESSEN, and H. E. MACMAHON—3:30. Case of adrenal dysfunction.
H. E. CHAMBERLIN—4. Genito-urinary surgery in children.
W. A. MACCOLL—4:30. Tonsils and adenoids, indications for removal.

### PALMER MEMORIAL HOSPITAL

Staff—9. Symposium: Carcinoma of the rectum and anus.
L. S. MCKITTRICK. Choice of operation in cases of carcinoma of the rectum.
W. F. LEADBETTER. Urological complications after excision of the rectum.
C. C. FRANSEEN. Use of electrocoagulation and radium implantation in poor-risk cases of carcinoma of the rectum.
J. H. MARKS. X-ray therapy of carcinoma of the rectum.
R. H. SWEET. End-results of treatment of carcinoma of the rectum and anal canal.

### ST. ELIZABETH'S HOSPITAL

Staff—9. Operative and dry clinic:
JOSEPH STANTON—9. Cholecystectomy.
JOHN SPELLMAN—9. Resection of large bowel.
JOSEPH STANTON—10. Hysterectomy.
FRANCIS JANTZEN—10. Herniorrhaphy.
WILLIAM SANTORO—11. Cholecystectomy.
MARTIN H. SPELLMAN—11. Herniorrhaphy.
ROGER T. DOYLE—11. Presentation of cases.
JOHN F. CASEY—11:45. The use of sulfonamides in general surgery.

### UNITED STATES NAVAL HOSPITAL

JOSEPH B. LOGUE—9. Operations.
LAWRENCE J. MCCARTHY and FRANKLIN G. BALCH, JR.—9. Operative and dry clinic: Gastro-intestinal diseases, partial gastrectomy for pyloric obstruction; synopsis of case histories.

## *Friday*

### BETH ISRAEL HOSPITAL

Staff—9. Dry clinic:
C. G. MIXTER. Results of surgery of colon neoplasms classified according to extent of lesion.
L. E. BARRON. Pitfalls in diagnosis of carcinoma of stomach, observations in 300 cases.
C. G. MIXTER. Results of surgery of gastric neoplasms classified according to extent of lesion.
I. T. NATHANSON. Surgical management of lymph nodes in cancer surgery.
K. PRESSER. Differential diagnosis of gastric ulcer by radiography.
JACOB FINE—10:30. Operation: Colon resection.
C. G. MIXTER—10:30. Operation: Gastric resection.
Staff—2. Dry clinic:
A. M. SELIGMAN. Vitamin $K_1$ in treatment of hypoprothrombinemia in infants.
J. J. MICHAELS and ETHEL COHEN. Psychiatric considerations in surgical patients.
B. E. F. RISEMAN. The surgical treatment of angina pectoris.
S. A. ROBINS. Diagnosis of non-calcified dermoid cysts.
A. M. SELIGMAN. Carcinogenic agents.
H. L. CABITT. Surgical management of pulmonary tuberculosis.
AARON THURMAN. Thoracic esophageal diverticulum.
NAAMAN STEINBERG. Injection treatment of hemorrhoids.

### BOSTON CITY HOSPITAL

Staff—2. Dry clinic:
C. G. SHEDD—2. Chemotherapy in general peritonitis.
MAXWELL FINLAND—2:30. Chemotherapy in surgery.
R. H. ALDRICH—3:15. The dymixal treatment of burns with especial reference to shock.
H. G. DUNPHY—4:15. "Z" plastics in burns.

### PETER BENT BRIGHAM HOSPITAL

ELLIOTT C. CUTLER and ROBERT ZOLLINGER—9. Operations: Cholecystectomy, choledochostomy.

ELLIOTT C. CUTLER and associates—10. Symposium: Surgical diseases of the biliary tract.

ELLIOTT C. CUTLER. Biliary calculus, technique of surgical therapy.

MERRILL C. SOSMAN. Upright films of the gall bladder as an aid in the diagnosis of cholelithiasis.

ROBERT ZOLLINGER. Acute cholecystitis.

THOMAS B. QUIGLEY. Surgery of the biliary tract in the aged.

WILLIAM A. DAVIS. Clinical use of vitamin K in surgery of the biliary tract.

EDWARD S. EMERY, JR. Medical treatment after cholecystectomy.

ELLIOTT C. CUTLER and associates—2. Symposium: Surgical treatment of hyperthyroidism.

ELLIOTT C. CUTLER. The domain of thyroid surgery.

SAMUEL A. LEVINE. Pre-operative and postoperative treatment of severe thyrocardiacs.

MARSHALL N. FULTON. Recurrent hyperthyroidism.

J. ENGLEBERT DUNPHY. Use of silk in surgery of the thyroid.

HARRY B. FRIEDGOOD. Rôle of the pituitary hormone in thyrotoxicosis.

ELLIOTT C. CUTLER. Technique of thyroidectomy.

### CARNEY HOSPITAL

A. MCK. FRASER, WILLIAM E. BROWNE, and staff—9. Operative clinic: Gastro-intestinal, biliary tract, thyroid, and hand.

### CHILDREN'S HOSPITAL

WILLIAM E. LADD and associates—9. Operations.

### MASSACHUSETTS GENERAL HOSPITAL

E. D. CHURCHILL, OLIVER COPE and associates—9. Symposium: Hyperparathyroidism.

J. C. AUB—9. Physiology of the parathyroid glands.

FULLER ALBRIGHT—9:20. Clinical aspects of hyperparathyroidism.

TRACY B. MALLORY—9:50. Pathology of the parathyroid glands.

OLIVER COPE—10. Surgical treatment of hyperparathyroidism.

F. A. SIMEONE—10:35. Renal complications of hyperparathyroidism.

Staff—11. Operative clinic.

Staff—2. Symposium: Peripheral vascular disease, acute venous thrombosis in veins of lower extremities, pulmonary embolism.

RICHARD WARREN—2. Fundamental considerations of thrombus formation, clinical manifestations, diagnosis and treatment.

H. H. FAXON—2:20. Pulmonary embolism, its relation to venous thrombosis.

RICHARD WARREN—2:45. The use of heparin in the prevention of pulmonary emboli.

C. E. WELCH and C. E. MCGAHEY—3. Venography, indications, technique, results.

H. H. FAXON—3:15. Exploration and division of the femoral vein, indications and operative technique.

C. E. WELCH—3:35. Results, early and late, after division of the femoral vein.

Staff—3:50. Discussion.

H. H. FAXON, C. E. WELCH, and RICHARD WARREN—4. Operative clinic.

### MASSACHUSETTS MEMORIAL HOSPITALS

HOWARD M. CLUTE, CLIFFORD D. HARVEY, CHARLES SZIKLAS, FRANK E. BARTON, and HOLLIS L. ALBRIGHT—8. Operative clinic: Thyroid, gall-bladder, stomach, and colon.

ELEANOR FERGUSON, REGINALD HUNT, and M. JEAN BLACK. Demonstrations: Anesthesia.

REGINALD HUNT—10:30. Dry clinic: Spinal headaches, preliminary report.

M. JEAN BLACK. Relative efficiency of different methods of oxygen therapy.

### NEW ENGLAND BAPTIST HOSPITAL

F. H. LAHEY, R. B. CATTELL, S. F. MARSHALL, and B. P. COLCOCK—9. Operative clinic: Thyroid, stomach, colon, and biliary tract.

U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—9. Anesthesia demonstrations: Regional, spinal, continuous spinal, and general.

H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum, and biliary tract.

U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Demonstrations: Anesthesia.

### NEW ENGLAND DEACONESS HOSPITAL

F. H. LAHEY, R. B. CATTELL, S. F. MARSHALL, and B. P. COLCOCK—9. Operative clinic: Thyroid, stomach, colon, and biliary tract.

U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—9. Anesthesia demonstration: Regional, spinal, continuous spinal and general.

H. D. ADAMS and N. W. SWINTON—1:30. Operative clinic: Thyroid, stomach, colon, rectum, and biliary tract.

U. H. EVERSOLE, LEO V. HAND, and M. J. NICHOLSON—1:30. Demonstration: Anesthesia.

### NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

Staff—10. Out-patient clinics: Gynecological, ophthalmological, vascular, and pediatric (cardiac).

### PALMER MEMORIAL HOSPITAL

Staff—2. Symposium: Diabetic gangrene.

H. F. ROOT. Medical aspects.

L. S. MCKITTRICK. Principles of surgical treatment; classification of lesions; conservative methods.

T. C. PRATT. Indications for and technique of minor amputation.

L. S. MCKITTRICK. Indications for and technique of major amputation.

T. C. PRATT. End-result study of 100 patients after supracondylar amputation for gangrene.

L. S. MCKITTRICK and T. C. PRATT—2. Operations: Supracondylar amputations for gangrene.

### ST. ELIZABETH'S HOSPITAL

JOSEPH STANTON and staff—9. Operations.

### SALEM HOSPITAL

Staff—10. Clinical pathological conference.

### UNITED STATES NAVAL HOSPITAL

CHARLES H. SWAN—9. Operations.

# OBSTETRICS AND GYNECOLOGY

## *Tuesday*

### BOSTON CITY HOSPITAL

Staff—2. Symposium: Pregnancy, the physiological and pathological aspects.

GEORGE R. MINOT and EUGENE L. LOZNER—2. The hemorrhagic diatheses complicating pregnancy.

FREDERICK J. LYNCH—2:30. Treatment of miscarriage.

FREDERICK PARKER, JR.—3. Pathology of toxemia of pregnancy with especial reference to changes in the placenta.

CARMI R. ALDEN—3:30. Disorders of the urinary tract encountered in obstetrics.

BENEDICT F. BOLAND—4. Hormonal relationship between the kidneys and toxemia of pregnancy.

MAXWELL FINLAND—4:20. Pneumonia in pregnancy.

### BOSTON LYING-IN HOSPITAL

Staff—10. Operative and dry clinic:

CHARLES A. JANEWAY. Treatment of puerperal sepsis with sulfanilamide and immune transfusions.

CLEMENT A. SMITH. Quantitative measurements of anesthesia and anoxia produced in mother and infant by obstetrical anesthetics.

### CARNEY HOSPITAL

LOUIS E. PHANEUF and staff—9. Operative clinic.

Staff—2. Dry clinic:

LOUIS E. PHANEUF. Manchester operation in management of uterine prolapse.

R. J. HEFFERNAN. Conservative management of premature separation of the placenta.

ROGER C. GRAVES and LOUIS E. PHANEUF. Management of difficult vesicovaginal fistula.

H. EDWARD MACMAHON. Biopsy of uterine cervix from the standpoint of the pathologist.

MAURICE O. BELSON. Uterine hemorrhage; technique of uterovaginal tamponade.

EDMUND L. CAREY. Analysis of breech deliveries at the Carney Hospital during the last 10 years.

WILLIAM C. MALONEY. Abnormal capillary fragility in the newborn.

### FREE HOSPITAL FOR WOMEN

JOHN ROCK and SIDNEY C. GRAVES—8. Gynecological operations.

Staff—9. Symposium: Carcinoma of the cervix.

FRANK A. PEMBERTON—9. Radium application. Demonstration of radium applicators.

FRANK A. PEMBERTON and RICHARD DRESSER—9:20. Present methods of radium and x-ray treatment.

ARTHUR T. HERTIG and PAUL A. YOUNGE—9:40. Diagnosis of early carcinoma, clinical and pathological.

GEORGE VAN S. SMITH—10:40. Complications and treatment.

PAUL A. YOUNGE—11. Management of the urological complications.

GEORGE VAN S. SMITH—11:20. Results and summary.

PAUL A. YOUNGE—11:45. Hysterectomy for early carcinoma of the cervix.

### NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

LETITIA DOUGLAS ADAMS, BLANCHE L. ATWOOD, ILIA GALLEANI, and GRACE E. ROCHFORD—9. Operations.

MARJORIE WOODMAN—2. Obstetrical analgesia.

ESTHER E. BARTLETT—2. Demonstration: Pudendal and parasacral blocks in obstetrical anesthesia.

### PALMER MEMORIAL HOSPITAL

G. A. LELAND, JR. and C. J. SWAN—2. Symposium: Treatment of carcinoma of the cervix.

### ST. ELIZABETH'S HOSPITAL

Staff—9. Demonstration: Technique of normal delivery.

FREDERICK L. GOOD and staff—10. Operations.

## *Wednesday*

### BOSTON CITY HOSPITAL

Staff—9. Dry clinic:

Speaker to be announced—9. Anesthesia and analgesia with special reference to spinal and intravenous anesthesia.

DR. REGINALD and R. D. MARGESON—9:30. Placenta previa in patients previously delivered by low transverse cesarean section.

FREDERICK L. GOOD—10. Physiology of the lower uterine segment.

DANIEL J. MCSWEENEY—10:30. Radiographic pelvimetry.

F. W. O'BRIEN—11. Results in treatment of carcinoma of the uterus in the tumor clinic of a general hospital.

FREDERICK PARKER, JR., and JOHN T. WILLIAMS—11:30. Pathology of so-called fibrosis of the uterus.

### BOSTON LYING-IN HOSPITAL

Staff—2. Dry clinic:

MEINOLPH V. KAPPIUS. The rôle of soft tissue x-ray technique in the diagnosis of placenta previa.

ROBERT N. RUTHERFORD. Interpretation of bleeding in the first trimester of pregnancy as shown by endometrial biopsies.

ARTHUR T. HERTIG. Pathological ova, chief cause of spontaneous abortion.

ROBERT H. BARKER. Determination of cephalopelvic disproportion by Thoms method of roentgenometry.

### CARNEY HOSPITAL

LOUIS E. PHANEUF and staff—9. Operative clinic.

### FREE HOSPITAL FOR WOMEN

EDWARD B. SHEEHAN and CHRISTOPHER J. DUNCAN—8. Gynecological operations.

Staff—9. Operative and dry clinic: Carcinoma of the endometrium.

FRANK A. PEMBERTON—9. Hysterectomy for carcinoma of the endometrium.

FRANK A. PEMBERTON and RICHARD DRESSER—10. Present methods of treatment, surgery, radium and x-ray.

ARTHUR T. HERTIG—10:30. Pathology and diagnosis of early carcinoma.

GEORGE VAN S. SMITH—11. Results and summary.

PAUL A. YOUNGE—11:30. Biopsy and cauterization of the cervix in ambulatory patients.

### NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

Staff—9. Operations.

MARJORIE WOODMAN—9:30. Obstetrical ward rounds.

MARJORIE WOODMAN—2. Obstetrical analgesia.

ESTHER E. BARTLETT—2. Demonstration: Parasacral and pudendal blocks in obstetrical anesthesia.

### PONDVILLE HOSPITAL

JOE V. MEIGS, LANGDON PARSONS, and associates—9. Operative clinic: Wertheim operation for cancer of the

cervix; dissection of pelvic lymph nodes (Taussig operation); radium treatment for cancer of the cervix.

ST. ELIZABETH'S HOSPITAL

CHARLES J. KICKHAM—9. Low transverse cervical section; plastic and laparotomy for prolapse of uterus.
FREDERICK L. GOOD and staff—10. Operations.

*Thursday*

BOSTON LYING-IN HOSPITAL

Staff—10. Operative and dry clinic:
JOHN L. NEWELL. External cephalic version as prophylaxis against the fetal hazards of breech presentations.
DANIEL ABRAMSON. End-results of a conservative policy at delivery as shown in a study of postpartum patients.

CARNEY HOSPITAL

LOUIS E. PHANEUF and staff—9. Operative clinic.

FREE HOSPITAL FOR WOMEN

SIDNEY C. GRAVES and PAUL A. YOUNGE—8. Gynecological operations.
Staff—9. Symposium: Fertility and hormones in gynecology.
JOHN ROCK—9. Technique, interpretation and value of endometrial biopsy.
JOHN O. HAMAN—9:30. Time relationship of ovulation to menstruation.
FRED A. SIMMONS—10. Evaluation and improvement of the male in a sterile mating.
JOHN ROCK—10:30. Clinical lessons from seven previllous embryos.
GEORGE VAN S. SMITH—11. Hormones in gynecology.
W. STEWART WHITTEMORE (from the Cambridge Hospital)—11:30. A case of artificial vagina, pregnancy and cesarean section.
Staff—2. Dry clinic:
PAUL A. YOUNGE—2. Results of presacral neurectomy for pelvic pain.
ROBERT TUCKER—2:30. A follow-up study of cases found to have cholelithiasis at the time of lower abdominal surgery.
PAUL A. YOUNGE—3. The treatment of interstitial cystitis.
FRANK A. PEMBERTON—3:30. The treatment of endometriosis.

MASSACHUSETTS MEMORIAL HOSPITALS

C. WESLEY SEWALL, JOHN J. ELLIOTT, and JOHN C. V. Fisher—8. Operative clinic: Low cervical cesarean, low forceps, mid-forceps; ward walk with demonstration of nursery.
C. WESLEY SEWALL and staff—2. Dry clinic:
JOHN J. ELLIOTT. A ten-year study at the Massachusetts Memorial Hospitals of bleeding in the third trimester of pregnancy.
OWEN C. MULLANEY. Prenatal and postnatal care.
JOHN C. V. FISHER. A ten-year survey of Cesarean section at the Massachusetts Memorial Hospitals.
MAX DAVIS. The physiology and clinical application of testosterone.
KENNETH W. SEWALL. A twenty-year survey of eclampsia at the Massachusetts Memorial Hospitals.
HERMAN C. PETTERSON. Modern care of the newborn.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

Staff—9. Operations.
MARJORIE WOODMAN—9:30. Operation: Cesarean. Previous operation on bicornate uterus.
MARJORIE WOODMAN—2. Demonstration: Obstetrical analgesia.
ESTHER E. BARTLETT—2. Demonstration: Pudendal and parasacral blocks in obstetrical anesthesia.

ST. ELIZABETH'S HOSPITAL

Staff—10. Dry clinic and ward visits: Technique of care of breasts in puerperium; review of cesarean sections for the past 10 years.
CHARLES J. KICKHAM—11. Plastic operation for lacerated cervix and perineum.

*Friday*

CARNEY HOSPITAL

LOUIS E. PHANEUF and staff—9. Operative clinic.

FREE HOSPITAL FOR WOMEN

GEORGE VAN S. SMITH and MEINOLF V. KAPPIUS—8. Gynecological operations.
Staff—9. Operative and dry clinic: Tumors of the ovary.
GEORGE VAN S. SMITH—9. Ovarian tumor.
ARTHUR T. HERTIG—10. Histogenesis and pathology of ovarian tumors.
RICHARD DRESSER—10:30. X-ray in the treatment of ovarian tumors.
FRANK A. PEMBERTON—11. Results in the treatment of carcinoma of the ovary.
SIDNEY C. GRAVES—11:30. Pruritus, kraurosis, leukoplakia and carcinoma of the vulva, etiology, treatment and results.

MASSACHUSETTS GENERAL HOSPITAL

JOE V. MEIGS and associates—9. Operative and dry clinic: Gynecological problems.
JOE V. MEIGS, LANGDON PARSONS and MARSHALL K. BARTLETT—9. Total abdominal hysterectomy for prolapse; Bassett's operation for cancer of the vulva; modified Kennedy operation for repair of urethral incontinence.
SOMERS STURGIS. Dysmenorrhea, treatment with estrogens.
WARD I. GREGG. Metropathia hemorrhagica, treatment with proluton.
IRA T. NATHANSON. Treatment for painful breasts with testosterone.
LANGDON PARSONS. Carcinoma of the vulva.
MARSHALL K. BARTLETT. Treatment for incontinence of urine.
JOE V. MEIGS. Fibroma of the ovary with fluid in the abdomen and chest.

NEW ENGLAND DEACONESS HOSPITAL

FRANK FOSTER—1:30. Dry clinic: Sterility problem; menstrual abnormalities.
B. P. COLCOCK—1:30. Dry clinic: Endometriosis; severe primary dysmenorrhea.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

Staff—9. Operations.
Staff—9:30. Dry clinic: Prenatal and postpartum care.

ST. ELIZABETH'S HOSPITAL

FREDERICK L. GOOD and staff—9. Operations.

UNITED STATES NAVAL HOSPITAL

JOSEPH B. DOYLE—10. Colored motion pictures of spinal anesthesia in obstetrics; discussion of case histories.

# THORACIC SURGERY

*Monday*

MASSACHUSETTS MEMORIAL HOSPITALS

JOHN W. STRIEDER and W. W. WOODRUFF (Saranac Lake, New York)—2. Symposium: Thoracic surgery. Suppurative pericarditis, colored moving pictures; lobectomy for bronchiectasis; tuberculous empyema.

NEW ENGLAND BAPTIST HOSPITAL

H. D. ADAMS—1:30. Operations.

NEW ENGLAND DEACONESS HOSPITAL

H. D. ADAMS—2. Operations.

Staff—2. Operative clinic: Non-tuberculous thoracic surgery.

*Tuesday*

NEW ENGLAND BAPTIST HOSPITAL

H. D. ADAMS—1:30. Operations.

NEW ENGLAND DEACONESS HOSPITAL

H. D. ADAMS—1:30. Operations.

Staff—2. Dry clinic: Symposium on total pneumonectomy.

REEVE H. BETTS. Determination of operability in primary carcinoma of the lung.

SHIELDS WARREN. Pathology of lung cancer.

RICHARD H. OVERHOLT. Exploratory thoracotomy in suspected malignancy.

BERT H. COTTON. Use of sulfathiazole in pulmonary resection.

ANDREW YEOMANS. Physiological observations made at time of pulmonary resection.

PHILLIP SCHULTZ. Problems of anesthesia in pneumonectomy.

HOWARD ROOT. Medical aspects of postoperative management.

Staff. Presentation of cases treated by pneumonectomy for cancer, tuberculosis, bronchiectasis, and cystic disease.

*Wednesday*

MASSACHUSETTS MEMORIAL HOSPITALS

JOHN W. STRIEDER—2. Operative clinic: Lobectomy for bronchiectasis; thoracoplasty for pulmonary tuberculosis.

NEW ENGLAND BAPTIST HOSPITAL

H. D. ADAMS—1:30. Operations.

NEW ENGLAND DEACONESS HOSPITAL

H. D. ADAMS—1:30. Operations.

*Thursday*

MASSACHUSETTS GENERAL HOSPITAL

E. D. CHURCHILL and associates—2. Operative and dry clinic: Suppurative lesions of the lung.

D. S. KING—2. Medical aspects of bronchiectasis, prognosis of untreated cases.

L. DAVENPORT—2:20. Technique of bronchography and anatomy of bronchial tree.

E. D. CHURCHILL—2:40. The surgical treatment of bronchiectasis.

R. H. SWEET—3. Surgical treatment of lung abscess, results.

E. D. CHURCHILL—3:30. Lobectomy and pneumonectomy in lung abscess.

ROBERT KLOPSTOCK—3:45. Discussion and exhibition of gross pathological specimens.

NEW ENGLAND BAPTIST HOSPITAL

H. D. ADAMS—1:30. Operations.

*Friday*

BOSTON CITY HOSPITAL

Staff—9. Operative and dry clinic:

J. W. STRIEDER—9. Colored motion pictures of suppurative pericarditis; result of modern method of treatment of putrid empyema; lobectomy for bronchiectasis.

HORACE BINNEY—9:45. Methods and results of treatment of pulmonary tuberculosis.

S. J. G. NOWAK—10:45. Experimental pulmonary embolus.

DR. SHULTZ—11:30. Intratracheal anesthesia for thoracic surgery.

NEW ENGLAND DEACONESS HOSPITAL

RICHARD H. OVERHOLT and R. H. BETTS—10. Dry clinic.

H. D. ADAMS—1:30. Operations.

Staff—2. Dry clinic: Symposium on total pneumonectomy.

REEVE H. BETTS. Determination of operability in primary carcinoma of the lung.

SHIELDS WARREN. Pathology of lung cancer.

RICHARD H. OVERHOLT. Exploratory thoracotomy in suspected malignancy.

BERT H. COTTON. Use of sulfathiazole in pulmonary resection.

ANDREW YEOMANS. Physiological observations made at time of pulmonary resection.

PHILLIP SCHULTZ. Problems of anesthesia in pneumonectomy.

HOWARD ROOT. Medical aspects of postoperative management.

Staff. Presentation of cases treated by pneumonectomy for cancer, tuberculosis, bronchiectasis, and cystic disease.

NEW ENGLAND BAPTIST HOSPITAL

H. D. ADAMS—1:30. Operations.

# ORTHOPEDIC SURGERY

*Tuesday*

CHILDREN'S HOSPITAL

FRANK R. OBER and associates—9. Operations.

NEW ENGLAND BAPTIST HOSPITAL

G. E. HAGGART and J. W. TOUMEY, JR.—9. Operations.

NEW ENGLAND DEACONESS HOSPITAL

G. E. HAGGART and J. W. TOUMEY, JR.—9. Operations.

*Wednesday*

ROBERT BRECK BRIGHAM HOSPITAL

Staff—9. Operative Clinic:
JOHN G. KUHNS. Arthroplasty of elbow.
ROBERT J. JOPLIN. Posterior capsularplasty of knee for flexion deformity.
WILLIAM A. ELLISTON. Osteotomy for malum coxae senilis.
Staff—2. Symposium: End-results in correction of arthritic deformities.
LORING T. SWAIM. Treatment of spinal arthritis.
JOHN G. KUHNS. Correction of contractures of the knee.
ROBERT J. JOPLIN. End-results in arthroplasties of elbow.
JOHN A. REIDY. Arthroplasties of knee.
WILLIAM A. ELLISON. Treatment of osteo-arthritis of hip.

CARNEY HOSPITAL

W. R. MACAUSLAND and staff—9. Operative clinic.

CHILDREN'S HOSPITAL

Staff—9. Dry clinic:
WILLIAM A. ELLISTON. Study in bone growth and resorption of the epiphyseal plate.
LEO J. MCDERMOTT. Equalization of leg length; leg lengthening.
PAUL W. HUGENBERGER. Tuberculosis of bone.
ALBERT H. BREWSTER. Arthrodesis of the foot in spastic paralysis.
Staff—11. Symposium: Infantile paralysis, operative treatment, round-table discussion.

MASSACHUSETTS MEMORIAL HOSPITALS

LOUIS G. HOWARD, KENNETH CHRISTOPHE, and WILLIAM ELLISTON—9. Operative clinic: Spinal fusion; hip reconstruction with vitallium cup.

NEW ENGLAND BAPTIST HOSPITAL

G. E. HAGGART and J. W. TOUMEY, JR.—9. Operations.

NEW ENGLAND DEACONESS HOSPITAL

G. E. HAGGART and J. W. TOUMEY, JR.—9. Operations.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

MIRIAM G. KATZEFF—9. Operations.
MIRIAM G. KATZELL—10. Dry clinic: Arthritis, fractures, x-rays of pathological bone conditions, clubfoot demonstration.

ST. ELIZABETH'S HOSPITAL

THOMAS F. BRODERICK—9. Spinal fusion.
THOMAS F. BRODERICK—11:30. Dry clinic: Motion pictures of author's technique of spinal fusion.

UNITED STATES NAVAL HOSPITAL

THOMAS H. PETERSON—9. Dry clinic: Shoulder injuries; discussion of case histories; x-ray findings.

*Thursday*

CHILDREN'S HOSPITAL

FRANK R. OBER and associates—9. Operations.

FAULKNER HOSPITAL

E. G. BRACKETT, H. C. MARBLE, G. M. MORRISON, J. L. DOHERTY, J. D. ADAMS, and OTTO J. HERMANN—8. Operative clinic.
HARVEY MORRISON. X-ray demonstrations.

MASSACHUSETTS GENERAL HOSPITAL

M. N. SMITH-PETERSEN and associates—2. Operative and dry clinic:
M. N. SMITH-PETERSEN, ARMIN KLEIN, J. S. BARR, and PAUL L. NORTON—2. Operations.
WILLIAM A. ROGERS—2. Fractures and fracture dislocations of the cervical spine, results of operative treatment.
GEORGE VAN GORDER. Amputations.
E. F. CAVE. Fractures of the carpal scaphoid, results of bone graft.
O. SHERWIN STAPLES. Effect on the knee joint of panastragalar arthrodesis.
OTTO E. AUFRANC, CARROLL B. LARSON, and M. N. SMITH-PETERSEN. Surgical procedures for relief of deformities arising from rheumatoid arthritis.
WALTER BAUER. Discussion.

MASSACHUSETTS MEMORIAL HOSPITALS

LOUIS G. HOWARD, ALBERT B. FERGUSON, and THOMAS J. ANGLEM—9. Symposium: Discussion of malignant bone tumors.

NEW ENGLAND BAPTIST HOSPITAL

G. E. HAGGART and J. W. TOUMEY, JR.—9. Operations.

NEW ENGLAND DEACONESS HOSPITAL

G. E. HAGGART and J. W. TOUMEY, JR.—9. Operations.

ST. ELIZABETH'S HOSPITAL

THOMAS F. BRODERICK and staff—9. Operations.

*Friday*

CARNEY HOSPITAL

W. R. MACAUSLAND and staff—9. Operative clinic.

CHILDREN'S HOSPITAL

Staff—9. Dry clinic followed by round-table discussion:
MIRIAM G. KATZEFF—9. Early treatment of clubfeet.
ROBERT H. MORRIS—9:20. Treatment of difficult clubfeet.
FRANK R. OBER—9:50. Treatment of congenital elevation of the scapula.
WILLIAM T. GREEN—10:20. Osteochondritis dissecans.
MEIER G. KARP—10:45. Fractures about the elbow in childhood.
Staff—11:15. Congenital malformations.

MASSACHUSETTS GENERAL HOSPITAL

M. N. SMITH-PETERSEN and associates—8:30. Operative and dry clinic:

G. W. VANGORDER, W. A. ROGERS, and E. F. CAVE—8:30. Operations.
ARMIN KLEIN, JOHN A. REIDY, and ROBERT J. JOPLIN—9. Slipped upper femoral epiphysis, results of operative and non-operative treatment.
JOSEPH S. BARR. Spinal fusion, frequency of pseudarthrosis.
M. N. SMITH-PETERSEN, CARROLL E. LARSON, and OTTO E. AUFRANC. Arthroplasty of the hip, results.

NEW ENGLAND BAPTIST HOSPITAL

G. E. HAGGART and J. W. TOUMEY, JR.—9. Operations.

NEW ENGLAND DEACONESS HOSPITAL

G. E. HAGGART and J. W. TOUMEY, JR.—9. Operations.

UNITED STATES NAVAL HOSPITAL

THOMAS H. PETERSON—9. Operations.

## GENITO-URINARY SURGERY

*Tuesday*

BETH ISRAEL HOSPITAL

Staff—9. Dry clinic:
E. G. CRABTREE. Pre-operative preparation of prostatic cases.
G. C. PRATHER and M. L. BRODNY. Accessory bladder pathology in prostatic cases.
G. C. PRATHER and MORTIMER REICH. Accessory renal pathology in prostatic cases.
E. G. CRABTREE. Summary of 12 years' experience in prostatic surgery.
G. C. PRATHER. Results of contact therapy for bladder tumors.
E. G. CRABTREE—10:45. Operation: Bladder tumor, contact radiation therapy.
Staff—2. Dry clinic:
E. L. PRIEN. Adaptation of the Tratner hydrophorograph for bladder studies.
ABRAHAM ZIMMERMAN. Bladder atonies.
J. H. LIPTON. Bladder atonies as demonstrated by the Tratner hydrophorograph.
S. R. MUELLNER. Testosterone effect on bladder tone; diabetic atony of the bladder.
B. E. GREENBERG. Value of cholinergic and adrenergic drugs in bladder atonies.
H. A. KONTOFF. Rate of recovery of bladder after relief of obstruction.
S. R. MUELLNER. Stress incontinence in the female.
E. L. PRIEN. Crystallography of the sulfonamide drugs.

CHILDREN'S HOSPITAL

WILLIAM E. LADD and associates—9. Dry clinic: Diseases of the genito-urinary tract in infancy and childhood, followed by questions and discussion.
WILLIAM E. LADD. Embryoma of the kidney (Wilms' tumor).
ROBERT E. GROSS. Surgical treatment of malformations.
THOMAS H. LANMAN. Exstrophy and epispadias.

MASSACHUSETTS MEMORIAL HOSPITALS

Staff—9. Operative clinic:
M. J. HAHN—9. Pyelotomy for stone.
DAVID B. STEARNS—10. Suprapubic prostatectomy.
SAMUEL N. VOSE—11. Perineal prostatectomy.

NEW ENGLAND BAPTIST HOSPITAL

E. E. EWERT and VERNON S. DICK—9. Operations.

NEW ENGLAND DEACONESS HOSPITAL

E. E. EWERT and VERNON S. DICK—9. Operations.

ST. ELIZABETH'S HOSPITAL

EDWARD J. O'BRIEN and associates—10. Operations.

*Wednesday*

MASSACHUSETTS GENERAL HOSPITAL

G. G. SMITH and associates—9. Operative and dry clinic:
Staff—9. Operations.
F. H. COLBY—10:30. Genito-urinary tuberculosis.
RICHARD CHUTE—10:50. Results of treatment with estrogenic substances in prostatic hypertrophy.
S. B. KELLEY—11:10. Complications of transurethral resection.
LORANDE WOODRUFF—11:40. The female urethra.
G. G. SMITH and associates—2. Operative and dry clinic:
Staff—2. Operations.
G. G. SMITH—3:30. Treatment of prostatic cancer.
ARTHUR WILLETS—3:50. Chronic prostatitis.
WYLAND LEADBETTER—4:10. Renal arteriography.
JOHN GENS—4:30. Urological endocrinology.

MASSACHUSETTS MEMORIAL HOSPITALS

Staff—9. Symposium: Obstructing prostate.
CLYDE L. DEMING (New Haven, Connecticut). Functional end-results following perineal prostatectomy.
EDWARD N. COOK (Rochester, Minnesota). Pre-operative preparation for transurethral prostatectomy.
SAMUEL N. VOSE. Selection of operative procedure.
JOSEPH F. MCCARTHY (New York). Technical aspects of prostatic resection with commentary on pharmacological adjuvants.

NEW ENGLAND BAPTIST HOSPITAL

E. E. EWERT and VERNON S. DICK—9. Operations.

NEW ENGLAND DEACONESS HOSPITAL

HARVARD H. CRABTREE—9. Operations.
E. E. EWERT and VERNON S. DICK—9. Operations.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

SUSANNAH FRIEDMAN—2. Dry clinic: End-results of pyelitis of pregnancy.

NEWTON HOSPITAL

E. G. CRABTREE, G. C. PRATHER, and E. L. PRIEN—9. Operations.
Staff—2. Dry clinic:
E. L. PRIEN. Analysis of calcifications and crystals in renal tissue.
G. C. PRATHER. Cystein stone and cysteinuria.
E. G. CRABTREE. Block dissections for renal tumor and cancer of the bladder.
G. C. PRATHER. Calyceal diverticula.
E. L. PRIEN. Multiple recurrent stones, palliation.
E. G. CRABTREE. Uretero-nephrectomy.
G. C. PRATHER. Graphic evidence of upper urinary dilatation with lower urinary obstruction.

PONDVILLE HOSPITAL

ROGER C. GRAVES and associates—9. Operative clinic: Carcinoma of the bladder.
Staff—11. Dry clinic:
ROGER C. GRAVES. Carcinoma of the bladder.
CHARLES C. J. KICKHAM. Urological complications in carcinoma of the rectum and colon.
WESTON T. BUDDINGTON. Urological complications in carcinoma of the cervix.

*Thursday*

BETH ISRAEL HOSPITAL

Staff—9. Dry clinic:
E. L. PRIEN. A new method for stone analysis.
D. B. STEARNS. Parathyroid disease and urinary lithiasis.
G. C. PRATHER. Roentgenology of the kidney at operation.
B. E. GREENBERG. Use of cholinergic and adrenergic medication for ureteral stone passage.
H. A. KONTOFF. Hospital statistics on urinary lithiasis.
J. H. LIPTON. Clearance of infection in stone cases after operation.
D. B. STEARNS. Diagnosis of calyceal calcifications.
H. A. KONTOFF. Renal tumor statistics of the hospital. Demonstration of surgical specimens of renal tumors with pyelographic and microscopic data.
E. G. CRABTREE—11. Operation: Excision of renal tumor.
Staff—2. Dry clinic:
M. L. BRODNY. Fractional phylography.
J. H. LIPTON. Sulfonamide drugs in surgical wounds and postoperative infections.
B. E. GREENBERG. Methylene blue treatment for tuberculosis of the bladder.
E. L. PRIEN. Renal injury from sulfathiazole and sulfapyridine, nature of the lesion.
D. B. STEARNS. Undescended testicle, age groups.
M. L. BRODNY. Urological study of enuresis cases.
DR. FISHMAN. Denervation of the kidney, end-results of 200 cases.
B. E. GREENBERG. Organization and function of a sterility clinic.
NATHAN CHASET. Hypertensive disease in urology.

BOSTON CITY HOSPITAL

Staff—9. Operative and dry clinic:
H. H. HOWARD—9. Epidermoid carcinoma of the penis.
GEORGE C. PRATHER—9:25. Stricture of the urethra.
S. R. MUELLNER—9:50. Newer concepts of urinary extravasation.
G. D. ATKINSON—10:15. Scrotal plastics after idiopathic gangrene.
W. H. HOLTHAM—10:40. Treatment of gonorrheal urethritis with sulfathiazole.
J. A. SETH—11:05. Removal of calculi from lower ureter by the vaginal route, report of 2 cases.
F. G. SHEDDAN—11:25. Fracture of the penis, case report. Anatomical study of remnants of prostate tissue in the prostatic bed following enucleation.
AUGUSTUS RILEY—11:40. Hemangioma of kidney, case report.

PETER BENT BRIGHAM HOSPITAL

WILLIAM C. QUINBY and associates—2. Symposium:
J. HARTWELL HARRISON. The diagnosis and treatment of common injuries of the urinary tract.
GEORGE AUSTEN. A correlation of the clinical aspects and pathology of the fused renal mass.
G. PHILIP GRABFIELD. Renal blood flow.
F. ANTHONY SIMEONE. Experimental hypertension.
WILLIAM C. QUINBY. A critical evaluation of prostatic surgery in recent years.

CARNEY HOSPITAL

ROGER C. GRAVES and staff—9. Operative clinic.

MASSACHUSETTS GENERAL HOSPITAL

G. G. SMITH and associates—9. Operative and dry clinic:
Staff—9. Operations.
HOWARD SUBY—10:30. Solution of urinary calculi.
RICHARD CHUTE—10:50. Problems in the treatment of urinary calculi.
F. H. COLBY—11:15. Deep x-ray therapy in cancer of the bladder.
S. B. KELLEY—11:40. Ureterostomy versus nephrostomy.

NEW ENGLAND BAPTIST HOSPITAL

E. E. EWERT and VERNON S. DICK—9. Operations.

NEW ENGLAND DEACONESS HOSPITAL

E. E. EWERT and VERNON S. DICK—9. Operations.

UNITED STATES NAVAL HOSPITAL

NICHOLAS G. SCARCELLO—9. Dry clinic: Presentation of urological cases with histories and x-ray findings.

*Friday*

MASSACHUSETTS GENERAL HOSPITAL

R. H. SMITHWICK and associates—2. Symposium: Surgery of non-nephritic hypertension.
ROBERT S. PALMER. Statement of the problem.
BENJAMIN CASTLEMAN. Renal pathology.
JOHN S. TALBOT. Renal physiology.
RICHARD CHUTE. Urological factors.
R. H. SMITHWICK. Modification of abnormal physiology by sympathectomy.

MASSACHUSETTS MEMORIAL HOSPITALS

Staff—9. Dry clinic:
DAVID B. STEARNS. Prostatovesiculitis simulating upper urinary tract symptomatology.
SAMUEL N. VOSE. Radical prostatectomy for cancer of prostate.
FRANK MORSE, JR. Congenital bladder neck obstruction in male children.
M. F. HAHN, JR. Review of urinary calculus at Massachusetts Memorial Hospitals for past 15 years.

NEW ENGLAND BAPTIST HOSPITAL

E. E. EWERT and VERNON S. DICK—9. Operations.

NEW ENGLAND DEACONESS HOSPITAL

E. E. EWERT and VERNON S. DICK—9. Operations.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

G. LINDH MULLER—10. Pathological demonstration: Congenital abnormalities of the kidney, nephrolithiasis.

# NEUROSURGERY

## *Monday*

### MASSACHUSETTS GENERAL HOSPITAL

J. C. WHITE and associates—2. Symposium: Neurological surgery.
J. C. WHITE and J. J. MICHELSEN—2. Operations.
W. J. MIXTER—4. Electro-encephalographic control of anticonvulsant therapy.
C. S. KUBIC and A. O. HAMPTON—4. Removal of lipiodol by lumbar puncture.
J. C. WHITE—4. Effect of anesthesia on volume of brain.

### NEW ENGLAND BAPTIST HOSPITAL

GILBERT HORRAX—1:30. Operations.

### NEW ENGLAND DEACONESS HOSPITAL

GILBERT HORRAX—1:30. Operations.

## *Tuesday*

### MASSACHUSETTS GENERAL HOSPITAL

J. C. WHITE and associates—9. Operative and dry clinic:
W. J. MIXTER and J. S. HODGSON—9. Operations.
J. C. WHITE—11. Presentation of operative results in angina pectoris and extrapyramidal tremors.
J. J. MICHELSEN—11. Treatment of torticollis by alcohol injection of cervical muscles.
J. C. WHITE and associates—2. Dry clinic:
W. J. MIXTER. Protrusion of nucleus pulposus in cervical spine.
J. S. HODGSON. Experience with cerebellar hemangiomas (Lindau's disease).
J. J. MICHELSEN. Subdural abscess.
W. H. SWEET. New methods for measurement of blood flow.
J. C. WHITE. Spinothalamic tractotomy in the medulla.

### NEW ENGLAND BAPTIST HOSPITAL

J. L. POPPEN—9. Operations.
GILBERT HORRAX—1:30. Operations.

### NEW ENGLAND DEACONESS HOSPITAL

J. L. POPPEN—9. Operations.
GILBERT HORRAX—1:30. Operations.

## *Wednesday*

### BOSTON CITY HOSPITAL

DONALD MUNRO and associates—9. Symposium: Injuries of the central nervous system and allied conditions.
DONALD MUNRO—9. Treatment of compound fracture of the skull, a study of 175 cases.
WALTER WEGNER—9:20. Concomitant cerebral tumors and craniocerebral injuries.
TIMOTHY LEARY—9:40. Pathology of craniocerebral injuries, with demonstration of specimens.
DONALD MUNRO—10:40. Study of 300 consecutive intracranial subdural hematomas.
WALTER WEGNER—11. Care of bone damage in cervical spinal cord injuries.
DONALD MUNRO—11:15. Present-day tidal drainage of the urinary bladder.
C. W. ELKINS—11:30. Two-needle oxygen spinograms with improved visualization of the spinal subarachnoid space.
DONALD MUNRO—11:45. Study of end-results in 130 cases of all levels of spinal cord injury.
DONALD MUNRO—12:10. Spinothalamic tractotomy in the medulla, intradural differential section of the sensory root of the fifth cranial nerve and other procedures of use in dealing with intractable pain in the head, face, mouth, neck, and arms.
DONALD MUNRO—12:20. Differential diagnosis and treatment of Ménière's disease and aural vertigo.
DONALD MUNRO—12:30. Prophylaxis and treatment of pressure bed-sores.

### NEW ENGLAND BAPTIST HOSPITAL

J. L. POPPEN—9. Operations.
GILBERT HORRAX—1:30. Operations.

### NEW ENGLAND DEACONESS HOSPITAL

J. L. POPPEN—9. Operations.
GILBERT HORRAX—1:30. Operations.

## *Thursday*

### CHILDREN'S HOSPITAL

F. D. INGRAHAM and associates—9. Symposium: Neurological surgery of children.
F. D. INGRAHAM—9. Neurosurgical problems of infancy and childhood.
BRONSON CROTHERS—9:30. Definition of recovery in terms of growth and development.
F. D. INGRAHAM—9:45. Congenital anomalies requiring surgical treatment.
F. D. INGRAHAM—10:15. Technical aids in neurosurgery of infancy and childhood.
F. D. INGRAHAM—10:30. Reliability of encephalography in infancy.
BRONSON CROTHERS—10:45. Presentation of cases.
SYDNEY FARBER—11. Pathological aspects of neurosurgery.
F. D. INGRAHAM—11:30. Excision of premotor cortex for athetosis.
F. D. INGRAHAM—12. Subdural hematoma.

### NEW ENGLAND BAPTIST HOSPITAL

J. L. POPPEN—9. Operations.
GILBERT HORRAX—1:30. Operations.

### NEW ENGLAND DEACONESS HOSPITAL

GILBERT HORRAX and associates—2. Operations:
GILBERT HORRAX. Ventriculogram and craniotomy for brain tumor.
J. L. POPPEN. Herniated intervertebral disc.

## *Friday*

### NEW ENGLAND BAPTIST HOSPITAL

J. L. POPPEN—9. Operations.
GILBERT HORRAX—1:30. Operations.

### NEW ENGLAND DEACONESS HOSPITAL

GILBERT HORRAX and associates—9. Dry clinic:
J. L. POPPEN—9. Results in herniated intervertebral discs, operations with and without fusions.
J. L. POPPEN—9:30. Platybasia demonstration.
GILBERT HORRAX—10. Experiences and results in brain tumors for the last 8 years.

## FRACTURES AND OTHER TRAUMAS

*Tuesday*

### BOSTON CITY HOSPITAL

OTTO J. HERMANN and associates—9. Symposium: Fractures of the ankle.
OTTO J. HERMANN. Introduction.
GORDON M. MORRISON. Simple unilateral ankle injuries with fracture.
JOSEPH BURNETT, G. G. BAILEY, JOSEPH SHORTELL, and RUSSELL SULLIVAN. Complicated ankle fractures, bilateral, following Cotton's therapeutical ankle classifications. Slides, charts, individual cases, and apparatus illustrating various points.

*Thursday*

### BEVERLY HOSPITAL

Staff—9. Operative and dry clinic:
PEER P. JOHNSON. Interesting fractures, end-results.
JOHN D. ADAMS. Injuries to hip joint; drilling of femoral neck in dislocation of hip joint.
RICHARD E. ALT. Open reduction in fractures and dislocations.
PAUL E. TIVNAN and JOSEPH A. CUNNINGHAM. Clinicopathological conference on bone tumors.
JACOB H. FINE. Demonstration of recently constructed operating amphitheater eliminating fire and explosion hazards.

*Friday*

### BOSTON CITY HOSPITAL

Staff—9. Symposium: Fractures of the hip.
NEWTON C. BROWDER—9. Intracapsular fractures of the hip.
RUSSELL SULLIVAN—9:30. Hip fractures, cases of operative reduction and internal fixation.
OTTO J. HERMANN—10. Painful un-united hip fractures.
THOMAS H. PETERSON—10:30. Posterior fusion of the hip.
A. A. THIBODEAU—11. Slipped femoral epiphysis.
JAMES W. SEVER—11:30. Presentation of cases.
DR. WISE (of New York)—11:45. Presentation of autopsy specimens of nailed fractured hips.

### MASSACHUSETTS GENERAL HOSPITAL

A. W. REGGIO, A. W. ALLEN, M. N. SMITH-PETERSEN, H. C. MARBLE, G. W. VANGORDER, and associates—2. Dry clinic.
Staff—2. Fracture rounds; presentation of current cases with open discussion.
Staff—3:30. End-result clinic; presentation of follow-up cases with open discussion of problems.

### UNITED STATES MARINE HOSPITAL

RICHEY L. WAUGH and associates—8. Operative clinic: Internal derangement of knee-joint; bunion, closed treatment, double-pin method; fracture both bones of leg, open treatment using vitallium plate.
RICHEY L. WAUGH and associates—1. Dry clinic:
RICHEY L. WAUGH. Skeletal traction and countertraction methods applicable to ordinary extension splints in the treatment of fractures of lower extremity.
THOMAS A. HATHCOCK. Use of vitallium in fractures.
RICHEY L. WAUGH. Injuries of the wrist.

## OTORHINOLARYNGOLOGY

*Monday*

### NEW ENGLAND BAPTIST HOSPITAL

F. D. LATHROP—1:30. Operations.

### NEW ENGLAND DEACONESS HOSPITAL

W. B. HOOVER and F. D. LATHROP—2:30. Local anesthesia in tonsillectomy, adenoidectomy, lingual tonsillectomy, and excision of lateral pharyngeal bands; septum; sinus surgery—Caldwell-Luc, external frontal, intranasal; plastic procedures, external nose.

### NEW ENGLAND MEDICAL CENTER

(Boston Dispensary—Joseph H. Pratt Diagnostic Clinic)
GEORGE KELEMEN—2. Pathogenesis of traumatic cholesteatome, lantern slides; surgery of the tonsil after middle-life; pathways of infection in the ear, lantern slides.
PHILIP E. MELTZER—2. Surgical anatomy of the temporal bone.

*Tuesday*

### BOSTON CITY HOSPITAL

Staff—9. Dry clinic:
E. J. MONAHAN—9:30. A method of the extirpation of bronchial cysts.
OSCAR HIRSCH—9:50. Cysts of pituitary body.
LOUIS M. FREEDMAN—10:10. Bronchoscopic treatment of pulmonary atelectasis.
CHESTER R. MILLS—10:30. Osteomyelitis of the frontal bones.
BENJAMIN RISEMAN—10:50. Gumma of nasopharynx and lung.
SAMUEL W. GARFIN—11:10. Treatment of fractures of the jaw.
PHILIP E. A. SHERIDAN, CHARLES DEWOLFE and FREDERICK HEIMLICK—11:30. Presentation of cases.

### CHILDREN'S HOSPITAL

Staff—9:30. Dry clinic:
CHARLES F. FERGUSON. Acute laryngotracheal bronchitis, report and statistical study of 40 cases.
C. G. FLAKE. Congenital anomalies of the tracheal bronchial tract; treatment of choanal atresia.
C. G. FLAKE and CHARLES F. FERGUSON. Chemotherapy in upper respiratory infections of children.

### MASSACHUSETTS EYE AND EAR INFIRMARY

Staff—2:30. Dry clinic:
A. S. MACMILLAN. Interpretation of sinus x-rays.
L. G. RICHARDS. Problems in bronchoscopy.
C. T. PORTER. Orbital abscess, diagnosis and treatment.
L. A. SCHALL. Cancer of the nose and sinuses.

### MASSACHUSETTS MEMORIAL HOSPITALS

Staff—2. Operative clinic:
HAROLD L. BABCOCK. Mastoidectomy.

BARNET WEIN. Radical sinus operation.
LEIGHTON F. JOHNSON. Fenestration for otosclerosis.

NEW ENGLAND BAPTIST HOSPITAL

WALTER B. HOOVER—9. Operations.
F. D. LATHROP—1:30. Operations.

NEW ENGLAND DEACONESS HOSPITAL

WALTER B. HOOVER—Operations.
F. D. LATHROP—1:30. Operations.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

ELIZABETH DEBLOIS, ISABELLE D. KERR, MARGARET NOYES KLEINERT, and MARY F. VASTINE—10. Demonstration: Use of the audiometer.

ST. ELIZABETH'S HOSPITAL

JOHN E. BURNS—9. Operative clinic: Radical frontal sinus; radical mastoidectomy.

UNITED STATES NAVAL HOSPITAL

CHARLES H. ALLMAN—9. Dry clinic: Bronchoscopy for bronchiectasis; pulmonary abscess and postoperative atelectasis; synopsis of case histories, end-results.
DAVID P. CORDRAY—9. Operations.

*Wednesday*

MASSACHUSETTS EYE AND EAR INFIRMARY

Staff—2:30. Dry clinic:
G. B. FRED. Osteomyelitis of the frontal bone.
H. G. TOBEY. Allergy, otolaryngological considerations.
P. E. MELTZER and C. I. JOHNSON. The fenestration operation.
RUTH GUILDER. The deaf child.
A. S. MACMILLAN. Interpretation of mastoid x-rays.

MASSACHUSETTS MEMORIAL HOSPITALS

LEIGHTON F. JOHNSON—2. Dry clinic: Mediastinitis, 3 cases, 2 cures (with Howard M. Clute); endaural repair of postauricular fistula, 3 cases; osteomyelitis of frontal bone; Lempert's operation, endaural fenestration for otosclerosis; ears in contagious diseases (with Conrad Wesselhoeft).

NEW ENGLAND BAPTIST HOSPITAL

WALTER B. HOOVER—9. Operations.
F. D. LATHROP—1:30. Operations.

NEW ENGLAND DEACONESS HOSPITAL

WALTER B. HOOVER—9. Operations.
WALTER B. HOOVER and F. D. LATHROP—2:30. Dry clinic: Diseases of the esophagus, summary of symptoms, diagnosis and treatment; carcinoma; cardiospasm; esophageal diverticulum; esophagitis; ulcers, strictures and perforation of the esophagus.

*Thursday*

BETH ISRAEL HOSPITAL

Staff—9. Dry clinic:
SAMUEL CLINE. Tuberculous laryngitis.
OSCAR HIRSCH. Sphenoid approach through submucous septum.
A. J. GORNEY. Lempert's simple and radical mastoid operations.
S. W. GARFIN. Transseptal approach for dacryocystitis.
H. F. FRIEDMAN. Radiation for carcinoma of larynx by the Coutard method.
BENJAMIN RISEMAN. Cavernous sinus thrombosis.
LOUIS M. FREEDMAN. Coutard radiation therapy for carcinoma of larynx, end-results; Lempert technique for simple and radical mastoidectomy.
LOUIS M. FREEDMAN. Lempert operation for mastoiditis.

BOSTON CITY HOSPITAL

Staff—9. Operations.

CARNEY HOSPITAL

BENJAMIN E. RISEMAN—2. Dry clinic: Edema of larynx with abscess formation.
CORNELIUS S. HICKEY—2. Dry clinic: Mastoiditis with complications.

MASSACHUSETTS EYE AND EAR INFIRMARY

Staff—9. Operations.
Staff—2:30. Dry clinic:
L. A. SCHALL. Laryngeal cancer.
V. H. KAZANJIAN. Rhinoplastic surgery.
PHILIP MYSEL. Labyrinthectomy, review of cases.
C. M. KOS. Meningitis, review of cases and discussion.

NEW ENGLAND BAPTIST HOSPITAL

WALTER B. HOOVER—9. Operations.
F. D. LATHROP—1:30. Operations.

NEW ENGLAND DEACONESS HOSPITAL

WALTER B. HOOVER—9. Operations.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

ELIZABETH DEBLOIS, ISABELLE D. KERR, MARGARET NOYES KLEINERT, and MARION C. SABIA—9. Operations.
Staff—10. Demonstration: Use of the audiometer.

ST. ELIZABETH'S HOSPITAL

WILLIAM T. HALEY—9. Operations.

*Friday*

BETH ISRAEL HOSPITAL

Staff—9. Operations.

CARNEY HOSPITAL

BENJAMIN E. RISEMAN and staff—9. Operative clinic.

MASSACHUSETTS MEMORIAL HOSPITALS

Staff—9. Operations.

NEW ENGLAND BAPTIST HOSPITAL

WALTER B. HOOVER—9. Operations.
F. D. LATHROP—1:30. Operations.

NEW ENGLAND DEACONESS HOSPITAL

WALTER B. HOOVER—9. Operations.
F. D. LATHROP—1:30. Operations.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

ELIZABETH DEBLOIS, ISABELLE D. KERR, MARGARET NOYES KLEINERT, and MARION C. SABIA—9. Operations.
ESTHER E. BARTLETT—10. Operations under endotracheal anesthesia.

NEW ENGLAND MEDICAL CENTER
(Boston Floating Hospital)

W. A. MCCOLL—2. Adenoid and tonsil problems.

## OPHTHALMOLOGY

### *Monday*

#### MASSACHUSETTS EYE AND EAR INFIRMARY

F. H. Verhoeff and William P. Beetham—2:15. Dry Clinic: Cataract surgery.

### *Tuesday*

#### BOSTON CITY HOSPITAL

James J. Regan and staff—9. Symposium: Abnormal fundi.

#### UNITED STATES NAVAL HOSPITAL

James J. Regan—9. Demonstrations of technique used in flight physical examinations, with discussions of United States Naval requirements.
Virgil G. Casten—10:30. Operations.

#### MASSACHUSETTS EYE AND EAR INFIRMARY

Paul A. Chandler, Fred S. Thorne, Trygve Gundersen, and Paul G. Haire—9. Operations.
William P. Beetham—9. Demonstration: Slit lamp.
Paul A. Chandler—2:15. Dry clinic: Glaucoma, indications for operation.
Samuel T. Clarke—3:15. Dry clinic: Goniotomy; medical treatment of glaucoma.

### *Wednesday*

#### MASSACHUSETTS EYE AND EAR INFIRMARY

William P. Beetham, Samuel H. Wilkins, Brendan D. Leahey, and David G. Cogan—9. Operations.
Garrett L. Sullivan—9. Demonstration: Perimetry.
E. B. Dunphy—2:15. Dry clinic: Strabismus, orthoptic training.
Virgil G. Casten—3:15. Dry clinic: Strabismus, operative treatment.

#### MASSACHUSETTS MEMORIAL HOSPITALS

William D. Rowland—9:30. Dry clinic.

### *Thursday*

#### BOSTON CITY HOSPITAL

James J. Regan and staff—9. Operations.

#### CARNEY HOSPITAL

George Gagliardi—2. Dry clinic: Suture and cataract extraction.
LeRoy Ford—2. Dry clinic: Orbital abscess in children.
Samuel T. Clarke—2. Contact lenses.

#### MASSACHUSETTS EYE AND EAR INFIRMARY

Edwin B. Goodall, Ralph H. Ruggles, Merrill J. King, and Herman Grossman—9. Operations.
Virgil G. Casten—9. Demonstration: Neuro-ophthalmology.
Merrill J. King—2:15. Dry clinic: Retinal separation.
Brendan D. Leahey—3:15. Dry clinic: Keratoplasty.

#### MASSACHUSETTS MEMORIAL HOSPITALS

William D. Rowland, Joseph J. Skirball, Edward L. Perry, and Ralph H. Hopkins—2. Operative clinic: Cataract, glaucoma, and muscles.

#### ST. ELIZABETH'S HOSPITAL

Hugh Donahue—10. Operations. Cataract extraction, decompression operation for primary glaucoma.

### *Friday*

#### CARNEY HOSPITAL

Samuel T. Clarke and staff—9. Operative clinic.

#### MASSACHUSETTS EYE AND EAR INFIRMARY

Benjamin Sachs and John G. Jennings—9. Operations.
Staff—9. Demonstrations.
Samuel T. Clarke. Gonioscopy.
T. L. Terry—2:15. Dry clinic and lantern demonstrations of pathological specimens.
V. H. Kazanjian—3:15. Dry clinic: Ophthalmoplastic surgery.

#### MASSACHUSETTS EYE AND EAR INFIRMARY

Scientific Exhibit

### *Daily*

T. L. Terry. Pathological laboratory open for inspection.
David G. Cogan. Howe laboratory and library open for inspection.